



## **Health of riding school horses in Denmark**

### **Clinical examination of the locomotor system**

Thomsen, Maj Halling; Kronborg, Susan; Agger, Jens Frederik Gramstrup; Pipper, Christian Bressen; Buhl, Rikke

#### *Published in:*

CONFERENCE PROCEEDINGS 10TH INTERNATIONAL EQUITATION SCIENCE CONFERENCE

#### *Publication date:*

2014

#### *Document version*

Early version, also known as pre-print

#### *Citation for published version (APA):*

Thomsen, M. H., Kronborg, S., Agger, J. F. G., Pipper, C. B., & Buhl, R. (2014). Health of riding school horses in Denmark: Clinical examination of the locomotor system. In J. Winther Christensen, J. Ladewig, L. P. Ahrendt , & J. Malmkvist (Eds.), *CONFERENCE PROCEEDINGS 10TH INTERNATIONAL EQUITATION SCIENCE CONFERENCE: 6 - 9 AUGUST 2014 AT VINGSTED HOTEL AND CONFERENCE CENTRE, DENMARK* (pp. 91). [Abstract no. 68 ] DCA Rapport No. 044  
<http://www.equitationsscience.com/documents/Conferences/2014/ISES%2010th%20Annual%20Conference%20Proceedings%20-%20DENMARK%202014.pdf>





# CONFERENCE PROCEEDINGS

## 10TH INTERNATIONAL EQUITATION SCIENCE CONFERENCE

6 - 9 AUGUST 2014 AT VINGSTED HOTEL AND CONFERENCE CENTRE, DENMARK

JANNE WINNTER CHRISTENSEN, JAN LADEWIG, LINE PEERSTRUP AHRENDT AND JENS MALMKVIST (EDITORS)

DCA REPORT NO. 044 • JUNE 2014



AARHUS  
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DCA - DANISH CENTRE FOR FOOD AND AGRICULTURE

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International Society  
for Equitation Science

### Theme: Equine stress, Learning and Training

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Views expressed in all contributions are those of the authors and not those of the ISES or publisher.



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Series: DCA report

No.: 044

Authors: Janne Winther Christensen, Jan Ladewig, Line Peerstrup Ahrendt and Jens Malmkvist (Editors)

Publisher: DCA - Danish Centre for Food and Agriculture, Blichers Allé 20, PO box 50, DK-8830 Tjele. Tlf. 8715 1248, e-mail: [dca@au.dk](mailto:dca@au.dk) Web: [www.dca.au.dk](http://www.dca.au.dk)

Photo: Elke Hartmann

Print: [www.digisource.dk](http://www.digisource.dk)

Year of issue: 2014

Copying permitted with proper citing of source

ISBN: 978-87-93176-24-9

ISSN: 2245-1684

Reports can be freely downloaded from [www.dca.au.dk](http://www.dca.au.dk)

### Scientific report

The reports contain mainly the final reportings of research projects, scientific reviews, knowledge syntheses, commissioned work for authorities, technical assessments, guidelines, etc.



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## **Scientific Committee**

**Chairs**      Dr. Janne Winther Christensen (Aarhus University)

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Dr. Camie Heleski (Michigan State University)

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Dr. Michela Minero (University of Milan)

Dr. Elke Hartmann (Swedish University of Agricultural Sciences)

Dr. Kathalijne Visser (Horsonality)

## **Welcome to Denmark for the 10<sup>th</sup> ISES conference**

We warmly welcome you to the 10<sup>th</sup> International Conference of the International Society for Equitation Science in Denmark. The organisers this year are scientists who, throughout their careers, have worked with stress biology, human-animal interaction and learning psychology, as well as being active riders. The programme of this year's conference reflects our scientific interests. Even though the study of stress in domestic animals goes back many decades, new theories and techniques are constantly developing. It is important to follow this development so that we are able to interpret the symptoms of stress and so that we can improve horse husbandry and equitation in ways that minimize stress. Undoubtedly, one source of stress in horses is caused by the way we train them. Therefore, the better we understand how horses experience the world around them, the more humane and effective our training methods will be. 'Maintenance' of the horse, physically as well as psychologically, is an area that needs more emphasis in the future so that equitation can become increasingly sustainable.

Luckily, the impact of the work being done in ISES is steadily growing. A good example of this impact is the recent collaboration with World Dressage Masters in the development of a Code of Conduct. An essential foundation for this work is research of high quality. We were therefore pleased to receive over 100 abstracts of presentations for this year's conference, even though it meant that we had to be rather strict in the selection process, particularly with a limited possibility for oral presentations. To avoid the prevailing impression that poster presentations are second rate or less important, the conference programme includes opportunity for authors to give short presentations of their work in front of their poster.

High quality science is important but it is equally important to integrate practitioners and lay people. Scientists need to communicate their results to the users and to keep an eye on what goes on outside the university. This year's practical sessions therefore demonstrate some of the activities that may benefit equitation and link theory and practise.

Scientific presentations and practical demonstrations are the reasons we hold a conference. But as any experienced conference-participant knows, an important part of getting together is to net-work and socialize, to link up with old friends and acquaintances and to meet new such ones. We hope that choosing a conference centre 'out in the bush', with little possibility of escape, will stimulate the socialization process that is so important not only for horses but also for humans.

We welcome you all to Denmark and sincerely hope for an inspiring conference!

On behalf of the local organising committee,

*Janne Winther Christensen*

*Jan Ladewig*

*Jens Malmkvist*



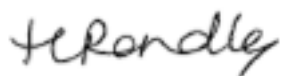
## President's welcome

It gives me great pleasure to welcome all conference delegates, whether old or new, to the 10<sup>th</sup> International Equitation Science Conference in Denmark. ISES is now in its eighth official year as a recognised learned society with a healthy academic and practitioner membership. Throughout this time the ISES Council and equitation science researchers alike have worked hard to support the ISES mission *to promote and encourage the application of objective research and advanced practice which will ultimately improve the welfare of horses in their associations with humans*. The overarching equine stress, learning and training theme of this conference sees a firm return to our biological roots. A substantial amount of work has been done to understand how horses learn, and how successful training can be achieved in the absence of confusion and conflict, through avoiding the incurring of a stress response. However, correlates with stress cannot be taken for granted and require almost continuous appraisal and evaluation. This point is emphasized clearly with papers examining the efficacy of possible indicators of stress including cortisol levels, heart rate and ECG measures, pain related scores and behavioural correlates. As is typical of ISES conferences a wide range of papers are included encompassing many aspects of equestrianism; from horse husbandry and care to high level performance. Papers are also included examining research protocols and the assessment of the impact of both riders and specific equitation-related equipment on physical and psychological levels. Furthermore a range of horse types are the subjects of these studies including riding school horses, dressage horses and stud horses.

One of the main drivers of ISES's work is the need to provide objective, evidence based knowledge to the end user- i.e. the equestrian practitioner – at all levels. The identification of ways of bridging this gap is crucial. In order to facilitate this, at least in part, each scientific abstract is accompanied by a Lay Persons Message to assist with the education of others.

I would like to extend my whole hearted thanks to the Local Conference Organising Committee for assembling not only for producing a full programme of academic presentations (talks and posters) and a varied practical day, but also for being the first in our relatively short history to schedule in physical activities.

Enjoy this conference, take home as many messages as possible, embed them into practice and spread them widely in order to help to ensure and safeguard the welfare of the equid whatever size, breed, purpose or monetary value. I am very much looking forward to the next few days, I hope you are too.



*Dr Hayley Randle*

## **Greetings from Her Royal Highness Princess Benedikte of Denmark**

It is a great pleasure for me to be the Patroness of the 10<sup>th</sup> International Conference of the International Society for Equitation Science here in Denmark.

As an active rider since childhood and the mother of one of the Danish elite dressage riders, the welfare and safety of horses and their riders have always been very important to me. Despite the fact that riding is based on generations of tradition, I particularly welcome the initiative of the Society to apply learning psychology to the training and riding of horses and to conduct scientific research on the interaction between horses and riders.

I am particularly pleased about the participation of delegates from so many different countries. Denmark is the country in the European Community with the largest number of horses per capita and riding has always played a big role for our country. For those reasons it is important for us to get as much inspiration from other countries and other cultures as possible, so that we are able to improve our status as a horse nation.

I welcome you all to Denmark and wish you a productive conference and a pleasant stay.

*Benedikte*

*Princess of Denmark*

## Programme

**10<sup>th</sup> International Equitation Science Conference, ISES August 7-9 2014**

### Equine stress, learning and training

<i>Wednesday August 6<sup>th</sup></i>		
Time	Event	Place
13:00-	Check-in at conference site is open Conference registration is open	Reception area
15:30-18:30	Pre-conference tour: BlueHors, bus departure 15:30 <small>Please note that this tour is kindly offered for free by BlueHors, and BlueHors is responsible for the content</small>	Meet outside of main entrance
18:00-20:00	Presenters can upload and test presentations Posters can be mounted	Auditorium Hall
20:00-21:00	Welcome reception with sandwich buffet and a drink	Reception area

<i>Thursday August 7<sup>th</sup></i>		
Time	Event	Location
07:30-08:30	Physical activities: nature walk, jogging/running	Meet in front of reception
08:00-09:00	Conference registration Presenters of today should upload and test presentations Posters should be mounted	Reception area Auditorium Hall
<b><i>Theme 1: Interpretation of equine stress responses</i></b>		
09:00-09:20	Welcome and opening of conference	Auditorium
	<i>Chair: Jens Malmkvist</i>	
09:20-10:00	<i>Plenary</i> An Introduction to Animal Stress: From Selye to Sapolsky <i>Mette S. Herskin</i>  <i>Abstract #1</i>	



10:00-10:45	<b>Plenary</b> Hormones as indicators of equine stress: Assessment of HPA-axis responses in horses <i>Rupert Palme</i> <i>Abstract #2</i>	
10:45-11:15	Coffee/tea at the posters	Hall
	<i>Chair: Camie Heleski</i>	
11:15-11:45	<b>Review presentation</b> Strengths and limitations of measuring HR, HRV & cortisol – <i>Visser</i> <i>Abstract #3</i>	Auditorium
11:45-12:00	Salivary cortisol responses of sports horses during a 4-days national show and the correlation to reactions in temperament tests – <i>Munk Andersen</i> <i>Abstract #4</i>	
12:00-12:15	Physiological difference between crib-biters and control horses in a standardised ACTH challenge test – <i>Freymond</i> <i>Abstract #5</i>	
12:15-12:30	Can equestrian professionals recognize signs of stress in the ridden horse? – <i>Hall</i> <i>Abstract #6</i>	
12:30-13:45	Lunch	Dining room
	<i>Chair: Paul McGreevy</i>	
13:45-14:00	Analysis of heart rate variability compared to a Composite Pain Scale as indicator of post castration pain in horses – <i>Stucke</i> <i>Abstract #7</i>	Auditorium
14:00-14:15	Monitoring acute equine visceral pain – construction of Composite Pain Scale & Facial Pain Expression Scale – <i>van Dierendonck</i> <i>Abstract #8</i>	
14:15-14:30	Responses of horses to sudden object and sudden noise in relation to direction and distance of the stimulus – <i>Pierard</i> <i>Abstract #9</i>	
14:30-14:45	Detection of ECG artefacts in horses: comparison between Textile and Standard electrodes – <i>Baragli</i> <i>Abstract #10</i>	
14:45-14:55	Summing up and poster address: Theme 1	
14:55-15:30	Coffee/tea at posters	Hall

<b>Theme 2: Learning and cognition</b>		
	<i>Chair: Natalie Waran</i>	
15:30-16:15	<b>Plenary</b> Stress, dopamine and the horse brain – implications for learning and training <i>Sebastian McBride</i> <i>Abstract #11</i>	Auditorium
16:15-16:45	<b>Review presentation</b> Personality influences cognitive capacities in horses: synthesis of a series of experiments – <i>Vidament</i> <i>Abstract #12</i>	
16:45-17:00	Short break	
17:00-17:15	Communication through symbol use: a novel method to study horse preferences for blanketing – <i>Mejdell</i> <i>Abstract #13</i>	
17:15-17:30	Foals' learning performance in four different learning tasks – <i>Ahrendt</i> <i>Abstract #14</i>	
17:30-17:45	Social transmission of habituation from mares to their foals – <i>Christensen</i> <i>Abstract #15</i>	
17:45-18:00	Summing up and poster address Theme 2 Announcements from the organisers	
18:30-20:00	Dinner	Dining room
20:00-21:00	An evening at the posters, coffee/tea	Hall

<b>Friday August 8<sup>th</sup></b>		
<b>Time</b>	<b>Event</b>	<b>Place</b>
07:30-08:30	Physical activities: nature walk, jogging/running.	Meet in front of reception
<b>Theme 2 (continued): Learning and cognition &amp; Free papers</b>		
09:00-09:15	Introduction to day 2 Announcements from the organisers Poster address Theme 2 and Free papers	Auditorium

	<i>Chair: Orla Doherty</i>	
09:15-10:00	<b>Plenary</b> Objectivity in dressage judging: New horizons that arise from learning theory <i>Andrew McLean</i> <i>Abstract #16</i>	
10:00-10:15	"And now the ankle a bit further back": Interaction analyses of trainers' and riders' work with horse-rider communication in dressage training – <i>Lundgren</i> <i>Abstract #17</i>	
10:15-10:30	The effects of patting and wither scratching on behaviour and heart rate of domestic horses – <i>Hancock</i> <i>Abstract #18</i>	
10:30-10:45	Linear personality and conformation trait evaluation system for horses shown in-hand: trait correlations and inter-observer reliability – <i>von Borstel</i> <i>Abstract #19</i>	
10:45-11:15	Coffee/tea at posters	Hall
	<i>Chair: Kathalijne Visser</i>	
11:15-11:30	Protocols for research in equitation science – <i>McGreevy</i> <i>Abstract #20</i>	Auditorium
11:30-11:45	Riding and road safety: building profiles of leisure riders and their environment in the United Kingdom – <i>Scofield</i> <i>Abstract #21</i>	
11:45-12:00	Bridging the Gap: Embedding the science into teaching and practice – <i>Waran</i> <i>Abstract #22</i>	
12:00-12:15	Summing up Information and introduction to practical afternoon - <i>Ladewig</i>	
<b>Practical afternoon: Ontogeny of the rider</b>		
12:30	Departure with bus to Billund Riding School (BIS) <small>The aim of the practical session is to provide a platform for discussions about training methods. We hope that the demonstrations will be inspiring in this regard, but please note that this part of the conference is not scientific and the demonstrated training methods and opinions of the trainers may not reflect the ISES mission.</small>	Outside of main entrance
13:00-13:20	Arrival and Lunch (pre-packed from Conference center)	BIS
	<i>Chair: Jan Ladewig</i>	
13:20-13:30	Welcome – <i>Ladewig</i>	
13:30-14:15	1 <sup>st</sup> session: Pony club education – <i>M. Hald Rasmussen</i>	
14:15-15:00	2 <sup>nd</sup> session: Fall techniques – <i>H. Sydendal &amp; P. Flodgaard</i>	



15:00-15:30	Coffee/tea break	
15:30-16:15	3 <sup>rd</sup> session: Show Jumping – <i>S. Kjærgaard</i>	
16:15-17:00	4 <sup>th</sup> session: Academic riding – <i>L. Gombeer, J. Verboven &amp; F. Ödberg</i>	
17:00-17:15	Summing up the afternoon – <i>Ladewig</i>	
17:15	Departure with bus back to Conference site	
19:00-	Conference party dinner	Large Restaurant

<b><i>Saturday August 9<sup>th</sup></i></b>		
<b>Time</b>	<b>Event</b>	<b>Place</b>
07:30-09:00	On-site swimming pool, sauna and spa open for participants	Swimming pool
<b><i>Theme 3: Sustainable training and riding</i></b>		
09:00-09:15	Introduction to Day 3 Announcements from the organisers Poster address Theme 3 and Free papers	Auditorium
	<i>Chair: Machteld van Dierendonck</i>	
09:15-10:00	<b>Plenary</b> Sustainable training and riding: Preparing horses for sportive activities <i>Arno Lindner</i> <i>Abstract #23</i>	
10:00-10:30	<b>Review presentation</b> Exercise-induced cardiac changes in the equine athlete – <i>Buhl</i> <i>Abstract #24</i>	
10:30-10:45	Activity patterns of trunk muscles in walk, trot and canter and their relation to different head-and neck-positions – <i>Kienapfel</i> <i>Abstract #25</i>	
10:45-11:15	Coffee/tea at posters	Hall
	<i>Chair: Uta König von Borstel</i>	
11:15-11:30	Risk factors for horse falls in the cross-country phase of one day events – <i>Cameron-Whytock</i> <i>Abstract #26</i>	Auditorium

11:30-11:45	Health of riding school horses in Denmark: Questionnaire survey of management and incidence of clinical disease – <i>Agger</i> <i>Abstract #27</i>	
11:45-12:00	The unshod horse: A competitive disadvantage in dressage? – <i>Mott</i> <i>Abstract #28</i>	
12:00-12:15	Rein tension used by riders during regular riding session – <i>Egenvall</i> <i>Abstract #29</i>	
12:15-12:30	Is elastic fantastic? The impact of elastic inserts on rein tension – <i>Randle</i> <i>Abstract #30</i>	
12:30-12:45	The influence of rider handedness on rider position – <i>Merkies</i> <i>Abstract #31</i>	
12:45-12:50	Summing up and poster address: Theme 3 and Free papers	
12:50-14:00	Lunch	Dining room
<b><i>Free papers</i></b>		
	<i>Chair: Andrew McLean</i>	
14:00-14:15	A Preliminary Investigation of Horses' Preference for different Ammonia Concentrations – <i>Weir</i> <i>Abstract #32</i>	Auditorium
14:15-14:30	Nordic winter weather and horse thermoregulation – <i>Jørgensen</i> <i>Abstract #33</i>	
14:30-14:45	Blanketing and clipping practices among Swedish horse owners – <i>Hartmann</i> <i>Abstract #34</i>	
14:45-15:00	A comparison of methods to determine equine laterality – <i>Kuhnke</i> <i>Abstract #35</i>	
15:00-15:05	Summing up and poster address: Free papers	
15:05-15:30	Coffee/tea at posters	Hall
15:30-16:00	Summing-up – <i>Christensen, Ladewig, Malmkvist</i> Student prizes Next ISES – short presentation by organisers Closing of conference & Good-bye	Auditorium
16:00-	Posters can be taken down	Hall
16:00-17:30	Annual General Meeting, AGM of the ISES. Including: Assessing the impact and viewpoints of attendees of the 2013 International Society for Equitation Science Conference – <i>Greene</i>	Auditorium

## **Biographies of Plenary speakers and Practical day presenters**

### **Mette Herskin**

*University of Aarhus, Denmark*

Dr. Mette S. Herskin completed her PhD in stress biology at the Royal Veterinary and Agricultural University in Copenhagen, focusing on links between nociception and responses towards acute stress in dairy cows. She now works as a senior scientist at Aarhus University, where her research links ethology and veterinary science, focusing on behaviour, stress, pain and disease in farm animals. She has been among the pioneers in the study of behavioural expressions of pain and nociceptive thresholds across animal species. As part of this work, she is currently board member of the Special Interest Group (SIG) of the International Association for the Study of Pain focusing on “Non-primate pain”. During the last years, she has been one of the organisers of the international PhD course “Interpretation of animal stress responses”.

### **Rupert Palme**

*University of Veterinary Medicine, Austria*

Dr. Rupert Palme studied Veterinary Medicine in Vienna and received his DVM in 1988. He continued his work at the Institute of Biochemistry of the University of Veterinary Medicine as Assistant Researcher and after his habilitation in Biochemistry in 1997 as Associate Professor. Since the habilitation his main research focus has been the metabolism and excretion of glucocorticoids, the characterisation of their metabolites in faeces, as well as the development and validation of EIAs for their quantification. He and his coworkers succeeded in establishing the world-wide first non-invasive method for stress-assessment in animals by measuring faecal glucocorticoid metabolites. Their assays are now applied successfully in an increasing number of bird and mammalian species in a variety of research fields such as animal welfare but also in ethological, ecological or biomedical studies. Recently, he has started radiometabolism studies with catecholamines, in order to set up methods to investigate the second “stress-axis” as well. Rupert has published more than 190 peer reviewed papers.

### **Sebastian McBride**

*University of Cambridge, UK*

Dr. Sebastian McBride completed a degree in Zoology at the University of Liverpool (UK) and a PhD in abnormal equine behaviour at the University of Edinburgh (UK), and continued his research at Aberystwyth University looking specifically at the neurophysiological mechanisms underpinning repetitive behavioural disorders. This line of investigation extended towards attributes of learning behaviour and computational models of brain systems as a way of better understanding some of the underlying mechanisms involved. He now works at the University of Cambridge developing cognitive tests as markers for normal and abnormal brain function in large animal species. Dr. McBride has



presented several papers at international conferences and written a number of articles for both the scientific and popular press on equine behaviour.

### **Andrew McLean**

*Australian Equine Behaviour Centre, Australia*

Dr. Andrew McLean is the senior vice president of ISES and brings together a rare combination of academic and equestrian achievement. In the early 1990's Andrew determined to explore the science of horse training. He found that very little had been scientifically identified or explained, leading to his PhD on the topic. As a prolific author of books and journal papers on the science and ethics of horse training, Andrew has won Australia's most prestigious science award, the Eureka Prize for Science along with Professor McGreevy and Dr. Bidda Jones. In Equestrian sport, he has represented Australia in Eventing, was short listed for the Australian team for the WEG in Stockholm in 1990, has ridden to Grand Prix in show-jumping and trained to Grand Prix in dressage. He developed and manages the Australian Equine Behaviour Centre; an internationally recognized horse training centre in Australia. Andrew is also well-known for his acclaimed systematic approach to elephant training in Nepal and India where his work is endorsed, continued and supported at government level.

### **Arno Lindner**

*Arbeitsgruppe Pferd, Germany*

Dr. Arno Lindner graduated from the Veterinary High School of Hannover, Germany, in 1981. He worked there in the Institute of Nutrition until 1984, pursued postgraduate studies on Tropical Veterinary Medicine at the Free University of Berlin in 1985, and in 1986 worked as a veterinarian for Pig International before joining in 1987 the Institute for Anatomy, Physiology and Hygiene of Domestic Animals of the University of Bonn, Germany. Since 1992 he is an independent contract researcher for pharmaceutical and feedstuff enterprises and organizes practical courses and conferences on diverse equine subjects, mainly on sport horse topics for experienced professionals. Since 1992 he leads an independent research group (Arbeitsgruppe Pferd) devoted to examine how to best diagnose performance and guide the training of sport horses.

## **Practical day presenters**

### **Mette Hald Rasmussen and Merete Stenner**

*Ædellund Shetland pony school*

Mette Hald Rasmussen started teaching children about horse care and riding as a way to make her increasing group of ponies pay for their feed. Over time, meeting the lonely and aggressive backyard ponies and their unhappy little handlers, she started to help children and ponies to a better and safer life together, and to help parents be realistic when their children pestered them about getting a pony.

In 2005 she was first introduced to horse training based on learning theory, and in 2010 she joined the first Danish instructor education based on equitation science and learning theory. She passed the final examinations in 2011 becoming a Blue Berry Hill Basic Instructor, and is now working fulltime at her and her husband's dairy farm, teaching young children how to train, drive, and ride ponies.

Co-presenter Merete Stenner has a Master's degree in husbandry science and a riding instructor education from Blue Berry Hill. In 2012 she started her own business as a riding instructor in her own riding school, offering private lessons, lectures, online courses and clinics. Merete's main emphasis is on riding safety and she gives lectures and courses on riding safety, horse behaviour, and learning theory.

### **Helle Sydendal and Palle Flodgaard**

*Faldteknik, Denmark*

Fall off without getting hurt: use judo falling techniques! "Once I saw Palle escape from a bike accident. He flew through the air but instead of getting hurt landing on the asphalt he used the judo falling technique and did not get hurt at all. I have seen riders do the same kind of fall, but breaking arms and shoulders or hurting their heads", says Helle Sydendal, a longtime rider and former editor of a Danish equestrian magazine. Besides being a recreational rider, Palle Flodgaard has a black belt in judo and he is the National and Nordic champion. Judo-fighters train falling techniques to avoid injuries, and this technique can be used by riders. Sydendal and Flodgaard have refined the concept of falling technique for riders over the years. Palle Flodgaard teaches riders at all levels - both young children and adult riders as well as beginners and experienced riders such as the national eventing team. Besides teaching a better falling technique, the exercises also give riders a better balance.

### **Susan Kjærgaard**

*BlueBerry Hill training center, Denmark*

Susan Kjærgård has been an active rider for 34 years; since 1996 as a professional rider and horse trainer, and for more than 12 years she was a permanent member of the Danish national team in show-jumping. Susan Kjærgaard has been in the top 100 of the world ranking list for show jumpers and won several medals in Danish and Nordic Championships. She won a bronze medal at The World Breeding Championships for young horses in Belgium and was placed in numerous World Cups, Grand Prix classes and Nations Cups. Susan Kjærgaard now runs a private horse training centre including education for instructors where learning theory and behaviour modification takes a central role. Susan believes in quiet, consistent and structured training that produces calm and confident horses. She no longer competes but works hard to spread the knowledge of equitation science in order to better the lives of riding horses and lower the amount of frustrations and harsh aids seen in training and competition all over the world.

## **Leopold Gombeer**

*The Belgian Riding Academy, Belgium*

Early in his career, Léopold Gombeer was involved in modern dressage competition. Because he did not like the training methods, he changed to academic riding. He competed in the Belgian A junior dressage team where he was trained by the famous dressage trainer George Theodorescu. As an academic rider, he studied under the supervision of Nuño Oliveira and Dr. Guilherme Borba; both icons within academic dressage.

He holds a Belgian degree of Riding Instructor from ADEPS (the official organization that regulates sport activities in Belgium). In addition, he has a Portugese degree as Equestrian Instructor. He is now the Technical Director of the Belgian Riding Academy. Apart from his equestrian activity, he breeds Lusitanos within the association Gombeer-Solvay-Barbieux.



# Abstracts

*Oral presentations*

## **Note**

Each abstract ends with a short message for lay persons (marked **LP**). The message is intended to briefly summarise the most important practical take-home message from the presented study.





## **An introduction to animal stress: From Selye to Sapolsky**

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The term “stress” is used in daily language as well as in the thousands of scientific papers published yearly in the field of animal science. But how did it all start? This plenary talk will present you to the ‘fathers’ of stress (e.g. Selye and Cannon), to learn from the original ideas leading to the current notion of animal stress (represented by e.g. Sapolsky). One major topic is the dual – adaptive as well as maladaptive – nature of stress. Stress can arise both as a consequence of adverse external stimulation and as a consequence of internal causal factors driving the animal to attempt to carry out species-specific behaviour, without having the right possibility or sufficient feedback. A cascade of events – e.g. activation of the autonomic nervous system (ANS) and of the hypothalamic-pituitary-adrenocortical (HPA) axis, as well as changes in behaviour – take place when animals anticipate or face stressors. Measuring e.g. HPA-axis activity or heart rate is among the common approaches used to quantify stress in horses as well as other farm animals. These measurements are usually combined with data from behavioural observations, production data, or pathological records in order to enhance interpretative validity. Besides their involvement in the stress response, hormones from the HPA-axis play a role in normal body functions, illustrated by increased plasma concentration in the late stages of sleep in many mammals (before waking up); a situation not usually considered as stressful. In general, factors such as predictability, control, and possibility for behavioural outlet can modify the stress response in a range of animals when faced with stressors (e.g. classical papers by Weiss 1968; 1971); these factors modulate the animals’ perception of stress. Additionally, persistent stress, certain diseases, and aging impair the feed-back action shutting down the stress responses in a range of mammals, thereby reducing their capacity to deal with stress. The behavioural reactivity of the animals, shaped by the interplay between genes and environment, can also affect the stress response.

**LP:** The aim of the talk is to give an introduction to stress, suggest some general definitions (for terms such as stressor, stress response, stress), and deal with major concepts within the field of animal stress. Hopefully this can set the scene for a common language, thereby promoting the interpretation of stress responses in horses.

## **Hormones as indicators of equine stress: Assessment of HPA-axis responses in horses**

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Stress responses play an important role in allowing animals to cope with challenges. Measurement of glucocorticoid levels, key elements in the neuroendocrine stress axis, can give insights into equine stress. They were traditionally determined in plasma samples. However, as blood sample collection itself disturbs an animal, non-invasive or minimal invasive methods have gained importance for assessing stress. In horses saliva and faeces are most frequently used. Faecal samples offer the advantage that they can be collected easily, safely and stress-free. In faecal samples circulating hormone levels are integrated over a certain period of time. As a consequence faecal glucocorticoid metabolites represent the cumulative secretion and they are less affected by short episodic fluctuations of hormone secretion. However, in order to gain reliable and valuable information about an animal's adrenocortical activity, certain criteria have to be met: Depending on whether the impact of acute or chronic stressors is assessed, frequent sampling might be necessary whereas in other cases, single samples will suffice. Background knowledge regarding the metabolism and excretion of glucocorticoids is essential and a careful validation is obligatory. In addition, this presentation will address analytical issues regarding sample storage, extraction procedures, and immunoassays and various examples of a successful application in horses will be given.

**LP:** Applied properly, non-invasive techniques to monitor equine stress hormones are a useful tool in different research fields, such as animal welfare and can open new perspectives in behavioural sciences.

## Strengths and limitations of measuring HR, HRV & cortisol

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Physiological measures like heart rate and cortisol are used in numerous studies to assess the level of stress, emotionality or pain in horses. Comparisons are made between handling/training regimes, housing, transport conditions and veterinary treatments. Heart rate measures include mean heart rate (HR) and heart rate variability (HRV). For HRV, different parameters are used to assess the balance between the parasympathetic and sympathetic branches of the autonomous nervous system, both in time and frequency domains. In numerous equine studies, cortisol levels have been measured in either saliva, blood or faeces. Typically, they interpret the data as ‘higher cortisol levels indicate a higher level of stress,’ but is that always the case? Cortisol tests are reasonably inexpensive, but interpreting the results can be challenging. Care must be taken to standardize the time of data collection (due to diurnal rhythm). When using these different parameters, are they valid to answer each study’s questions? How should researchers interpret the results when the HR/HRV and/or the cortisol data do not seem to “fit” with the behavioural observations? This paper will present a review of the strengths and limitations of measuring heart rate, heart rate variability and cortisol in terms of assessing horse behaviour, horse welfare, horse pain and horse “stress.” For this review, search engines were applied with keywords stress, welfare, horse, heart rate, cortisol (>200 hits for year 2000+). 20 articles were chosen for this review. Comparisons will be discussed when evaluating acute events versus more chronic scenarios, as well as how/if physiological measures such as HR, HRV and cortisol can distinguish between positive emotional states (e.g. anticipating something “good” happening) versus negative states (e.g. response to an aversive stimuli). Additionally, when a testing situation involves physical exertion, is it possible to separate out the impacts of this exertion as compared to the psychological elements? Lastly, from research conducted to date, there are threshold points at which we should always be concerned.

**LP:** Physiological measures of pain, distress, frustration, emotionality etc. can often contribute to our understanding of a horse’s emotional state and potentially its welfare status. However, tremendous care must be used in interpreting physiological measures, especially if not carefully related to behavioural observations. There is still a tremendous need for more research and additional collaboration in this area.

## **Salivary cortisol responses of sports horses during a 4-days national show and the correlation to reactions in temperament tests**

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Sports horses are frequently stabled and exercised in novel environments in connection with competitions and shows. This environmental change typically leads to increased baseline cortisol levels, depending on how stressful the horse perceives the new environment. This study aimed to investigate: 1) baseline and post-exercise salivary cortisol concentrations during a 4-days national show, compared to the home environment and 2) whether baseline cortisol concentrations at the show reflected behavioural reactions and heart rate in temperament tests in the home environment. Fifty-two Danish warm-blood horses, selected for a national show, were used in this study (30 stallions, 10 mares, 12 geldings, age 3-10 years; mean 4.8 y). The horses were sampled for salivary cortisol on two consecutive days in their home environment and on days 2-4 during the show. Baseline samples were collected between 7-9, 12-14 and 17-19 h. Post-exercise samples were collected approximately 10 minutes after exercise and time of day for exercise was recorded. Two weeks before the show, two temperament tests were performed in the horses' home environment (moving object test (MO) and bridge test (BT)). Latency time (lat) to complete the tests, frequency of snorting (FS), average (HRavg) and peak heart rates (HRpeak) were recorded. As expected, baseline cortisol concentrations were higher (44-86%) at the show than at home and remained high throughout the show (Mixed models, mean±se, ng/ml, Day1 home: 0.97±0.66, Day 2 home: 1.13±0.78, Day 2 show: 1.49±1.13, Day 3 show: 1.75±1.09, Day 4 show: 1.96±1.39,  $P<0.001$ ). Post-exercise levels were higher at the show than at home (mean±se, ng/ml, home: 1.65±1.23, show: 4.22±1.77,  $P<0.001$ ). Cortisol baseline concentrations at the show correlated with reactions in the MO (Spearman; lat:  $r=0.36$ ,  $P=0.018$ ; FS:  $r=0.36$ ,  $P=0.003$ ; HRavg:  $r=0.32$ ,  $P=0.041$ ) and tended to correlate to the latency in the BT ( $r=0.32$ ,  $P=0.055$ ). Reactions in the MO test may have reflected fearfulness which in turn may predict reactions to stabling in a novel environment. The horses did not return to home baseline concentrations during the 4-days show, indicating that the period was too short for habituation to occur.

**LP:** As expected, salivary cortisol was excreted at higher concentrations during a 4-days show compared to at home. Additionally, the reactions of horses in standardised temperament tests in the home environment do to some extent reflect their cortisol responses at the show. Horses that were tested more reactive likely perceived the show situation as more stressful.

## **Physiological difference between crib-biters and control horses in a standardised ACTH challenge test**

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Stereotypies are repetitive and relatively invariant patterns of behaviour, apparently functionless, which are observed in a wide range of species in captivity. They can occur when a situation exceeds the natural regulatory capacity of the organism, and particularly in situations that include unpredictability and uncontrollability (e.g. chronic stress). Many studies have proposed that stereotypic behaviour may serve as a coping mechanism, but results are contradictory. We measured the endocrine responsiveness of 21 crib-biters and 21 control horses in a standard ACTH challenge test, which triggers a physiological stress reaction, in order to better understand the coping process of stereotypies. Heart rate was measured continuously and saliva cortisol was taken every 30 minutes for 3 hrs. We did not find any difference in heart rate or RMSSD between groups. However, crib-biters had a higher cortisol response during the ACTH challenge test (Mean±SE: crib-biters, 5.36±3.00 ng/ml; controls, 4.28±3.33 ng/ml; Linear mixed model (LMM),  $P < 0.01$ ). Interestingly, it seems that this difference in cortisol was largely due to the crib-biters that did not crib-bite during the test (5.9±3.06). Indeed, these horses had higher cortisol responses than all other horses. Our results suggest that crib-biting horses differ from control horses in their HPA axis reactivity. This difference could be a consequence of chronic stress and/or genetic predisposition. Crib-biting might be a successful coping strategy that helps horses to gain control over situations and reduces cortisol levels. We concluded that crib-biters might have a genetic difference in HPA axis and that this behaviour seems to have some beneficial feedback.

**LP:** Preventing crib-biters to crib-bite could be counter-productive because this behaviour seems to have some beneficial feedback for horses.

## **Can equestrian professionals recognize signs of stress in the ridden horse?**

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The assessment of ridden horse behaviour by twelve equestrian professionals (instructors n=4, riders n=4, veterinary surgeons n=4) was compared with observed behaviour and physiological measures (salivary cortisol and eye temperature). Horses (n=10) were ridden at walk, trot and canter in a pre-defined test of approximately 2-3 minutes. Video footage of the ridden test (RT) was observed by the professionals who scored the horses on seven performance parameters derived from the Fédération Equestre Internationale (FEI) rules for dressage and the training scale of the German National Equestrian Federation (relaxation, energy, compliance, suppleness, confidence, motivation and happiness). The same video footage was analysed using Observer XT 10 and duration of behavioural states/events recorded. Saliva was collected prior to and throughout the RT and analysed for changes in cortisol concentration (ng/ml). Eye temperature was measured using an infrared thermal camera (MobIR® M8), using static images before and after the RT, and video footage during the test. Mean maximum eye temperatures during ridden work were calculated. Correlations between behavioural and physiological measures were investigated (Spearman's Rank Order Correlation). Increases in salivary cortisol positively correlated with the duration of low head carriage (nose below abdominal line:  $P < 0.05$ ). Increased eye temperature positively correlated with duration of nose carried behind the vertical when ridden ( $P = 0.02$ ) and negatively correlated with duration of nose carried in front of the vertical ( $P = 0.01$ ). Higher percentage durations of high head carriage (nose above the withers: ranging from 0-50.75% of RT) and the nose carried at an angle in front of the vertical (0-74.29% of RT) correlated with overall less favourable assessment by the equestrian professionals ( $P < 0.05$ ) and only the instructors associated neutral head carriage (nose between withers and abdominal line: 32.76-91.92% of RT) and vertical nasal angle (0.97-68.90% of RT) as a positive sign ( $P = 0.03$  and  $P = 0.04$  respectively). Some discrepancy between physiological evidence and professional assessment, and by different professionals, was evident. Further evaluation of the association between behavioural signs in ridden horses and physiological measures is now required.

**LP:** The interpretation of ridden horse behaviour by equestrian professionals (vets, trainers and riders) was found to differ from that suggested by physiological evidence. Vets scored high head carriage negatively but low head carriage resulted in increased physiological signs of stress. Only trainers scored neutral head carriage (nose between withers and abdominal line) positively. Further investigation is required to accurately evaluate ridden horse behaviour.

## **Analysis of heart rate variability compared to a Composite Pain Scale as indicator of post castration pain in horses**

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The aim of this study was to assess the validity of heart rate variability (HRV) analysis to identify post castration pain in horses. 51 stallions undergoing routine castration under general anaesthesia were divided in 3 pain-relieving treatment groups: A single perioperative administration of flunixin meglumine (1,1 mg/kg body weight *i.v.*) (n=19); B additional subsequent flunixin meglumine administrations (1,1 mg/kg body weight *p.o.*) (n=21); D as group A, but with additional local anaesthesia of the spermatic cords (10 ml mepivacaine 2%) (n=11). HRV was analysed in 300 sec sequences of recorded ECGs before and four times after surgery (up to 32 hrs) focussed on frequency-domain analysis (LF and HF). Pain related behaviour was assessed by means of a modified Composite Pain Scale (CPS). The same parameters were measured in a control group C, undergoing general anaesthesia for different non-painful procedures (n=6). HRV data was analysed with a mixed model ANOVA followed by post-hoc t-tests with Bonferroni alpha correction and CPS data was analysed with GLIMMIX procedure and Holm Tukey adjustment for post-hoc tests. All analysis was done using SAS (version 9.3). Measurement time point and treatment group both had a significant impact on HRV and CPS ( $P < 0.001$ ). HF power increased, LF power decreased significantly in groups A and B 4 hrs after surgery ( $P \leq 0.0002$ ). Group C reacted in the opposite way and was significantly different from groups A and B (LF  $P \leq 0.0002$ , HF  $P \leq 0.0006$ ) and D (LF  $P = 0.001$ ) 4 hrs after castration. CPS scores increased significantly in groups A and B ( $P \leq 0.0016$ ) but not in group D at 4 and 8 hrs after castration, or in group C. Post castration pain could be reliably measured and differentiated from the effect of anaesthesia by HRV analysis as well as by applying a CPS. Due to the pain localisation and transmission in the pelvic region, HRV analysis shows an increase in parasympathetic activity in contrast to different studies reporting a sympathetic activation as response to pain in other body regions. This work is part of the EU-project “Animal Welfare Indicators (AWIN)” (FP7-KBBE-2010-4).

**LP:** Analysis of heart rate variability (HRV) proved to be a reliable method measuring post castration pain in stallions. In contrast to pain from other body regions, pelvic pain causes parasympathetic activation. The responses of the autonomic nervous system to pain vary as a function of pain localisation and transmission. This factor has to be kept in mind using HRV analysis as pain indicator.

## **Monitoring acute equine visceral pain – construction of Composite Pain Scale & Facial Pain Expression Scale**

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Recognition and treatment of equine pain have been studied extensively over the last decades. However, there is still need for improvement in the ability to objectively identify pain in horses with acute colic. This study assessed validity and clinical applicability of two Composite Pains Score systems: Equine Utrecht University Scale for COMposite Pain ASSEssment (EQUUS-COMPASS - 14 parameters) and EQUUS-Facial Assessment of Pain (EQUUS-FAP - 9 parameters) in horses with acute colic. Control horses were assessed to be free from lameness and/or teeth problems. The set-up was a cohort follow-up study using 50 adult horses (n=25 horses with acute colic and n=25 controls). The EQUUS-COMPASS and -FAP scores were assessed from direct observation and videos of patients and controls as well as by Visual Analogue Scores (VAS) from video clips. Patients were assessed at arrival in the vet clinic, at the first and second morning after arrival. Control horses were assessed once in the same box. Both the EQUUS-COMPASS and -FAP scores showed high inter-observer reliability (ICC=0.98 for COMPASS, ICC=0.93 for FAP,  $P<0.001$ ), while a weak inter-observer reliability for the VAS scores was found (ICC=0.63,  $P<0.001$ ). Internal validation by specificity and sensitivity for differentiating between control horses and colic patients (n=50) was good for both EQUUS-COMPASS (sensitivity 95.8%, specificity 84.0%) and EQUUS-FAP (sensitivity 87.5%, specificity 88.0%). Internal specificity and sensitivity differentiating between conservatively treated and surgically treated (or euthanized) patients (n=25) was good for EQUUS-COMPASS (sensitivity 80.0%, specificity 85.7%). There was no difference between age, gender or breed. Development over time of conservatively treated horses (n=13) showed a significant decrease for EQUUS-COMPASS ( $P=0.021$ ) and FAP ( $P=0.012$ ). The combined results allowed calculating weighting factors for the individual parameters for the external validation phase: the EQUUS-COMPASS and -FAP are currently externally validated with a new cohort of patients with acute colic and controls in both the vet and ambulatory clinic. The EQUUS scores will improve the objective and repeated assessment of the severity of pain horses with acute colic and allow for good comparisons between different observers. This will be of benefit when different clinicians, caretakers and owners are involved in the care of a single patient.

**LP:** Two composite pain scores systems were tested in horses with acute colic and normal controls. The high agreement between scoring persons and high predictive value to distinguish patients from non-patients was promising and allowed for repeated assessment of pain in the abdomen.



## **Responses of horses to sudden object and sudden noise in relation to direction and distance of the stimulus**

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The reactions of horses to unexpected objects or noises can lead to dangerous situations. The aim of this study was to look at the potential impact of the direction and the distance of the stimulus on the intensity of the response. Data of sudden object and sudden noise tests performed on 43 warm-blood horses of the Belgian mounted police (mean age 12 years, average of 8 years' experience) were analysed. Analysis included locomotion (stand, walk, trot, canter), bucking, rolling and whinnying as measures of the intensity of the response. For comparisons of 3 categories a Kruskal-Wallis test was used, for 2 categories a Wilcoxon ranked sum test. The sudden object was an umbrella falling down from the ceiling. Comparing the 3 directions of the falling umbrella in relation to the body of the horse (front, side, back) showed no significant differences. Comparing close (within 5 m of the umbrella when it falls) to far showed only one significant difference: the rate of walking was larger for close than for far ( $P=0.028$ ). The response when the umbrella was suddenly lifted up again was not significantly different for close and far. Comparing the 3 directions, the only difference was that the proportion of time at canter was larger for side than for front ( $P=0.042$ ). The sudden noise test was a playback of a machinegun salvo. Comparing the same 3 directions (noise from front, side or back in relation to body of horse) there was a significant difference for the rate of standing ( $P=0.012$ ), with front having a higher rate than both side and back. Comparing 3 distances (close, middle, far from the sound system) there were significant differences for proportion of time walking ( $P=0.04$ ), mean duration of trot ( $P=0.023$ ) and amount of canter ( $P=0.037$ ). In conclusion, there was very little difference for direction or distance during the sudden object test. The sudden noise test showed some differences in type of locomotion but not systematically. In these tests with police horses distance and direction of sudden object and noise seemed to have little impact on the locomotion response. The training of the police horses with emphasis on habituation may be important so this should be repeated looking at other horses with different training backgrounds and in different environments.

**LP:** Police horses were tested for reaction to suddenly appearing/disappearing objects and sounds. Limited influence of the direction and the distance of the sudden stimulus was found on the movement of the horse soon after. If this is confirmed for other horses it could mean that direction and distance of a startling event are not crucial to the reaction of a trained horse.

## **Detection of ECG artefacts in horses: comparison between Textile and Standard electrodes**

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In this work, we compared standard (FS50LG, EF Medica™) and textile electrode (Smartex™) performance for acquiring ECG signal from horses. The textile electrodes were completely integrated in a textile support and were realized by combining conductive yarn (based on stainless steel fibres) and elastane. A multi-layered structure is used to increase the quality of the skin-electrode contact. Two identical devices were used for the simultaneous ECG acquisition with standard (Std-E) and textile (Tex-E) electrodes. Both Tex-E and Std-E were placed at the same positions on the chest (without shaving) through a chest belt. The signals from the Tex-E and Std-E were continuously acquired by a dedicated electronics (3 x 2 x 0.5 cm) that wirelessly transmits the data to a remote station through 802.11b communication protocol. Performances of both electrodes were evaluated by comparing the percentages of ECG artefacts in the two simultaneous acquisitions. Seven horses were recruited in a two-phase experimental session. In the first phase, horses were free to move in the stall for one hour (T60) while ECG was acquired. Afterwards, signal acquisition continued with a 15 minute walk in-hands along a standardised pathway (T15). The ECG signals were pre-filtered in order to remove the baseline and the high frequency noise; afterwards they were segmented in windows in which at least one complete QRS complex was present. A signal processing algorithm to estimate the motion-induced artefacts was developed based on Stationary Wavelet Transform using a multi-resolution threshold method. The percentage of artefacts was then analysed with paired t-test ( $P < 0.05$ ). The Bland-Altman plot revealed correlation between Std-E and Tex-E electrodes. Furthermore, a statistically significant lower percentage of ECG artefacts was detected with Tex-E than Std-E in both T60 ( $8.1 \pm 1.7$  vs.  $12.3 \pm 3.0$ ,  $n=7$ ,  $t_6 = -4.58$ ,  $P=0.0038$ ) and T15 ( $29.6 \pm 6.9$  vs.  $56.7 \pm 20.1$ ,  $n=7$ ,  $t_6 = -4.64$ ,  $P=0.0035$ ). In addition to well-known advantages of comfort and simplicity in using, textile electrodes showed better technical performances than standard electrodes. Although preliminary, these good results indicate that smart textiles can be profitably employed to collect short term ECG in horses, both during rest and light physical activity.

**LP:** After proper “gold standard” validation, textile platforms could be easily adopted in horses to collect parameters related to Autonomic Nervous System activity, such as heart rate variability, respiratory rate, peripheral measures of cardiovascular and respiratory functioning, electro-dermal response, skin secretion of stress-related hormones, etc.

## **Stress, dopamine and the horse's brain; implications for learning and training**

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The striatum is a pivotal structure within the basal ganglia brain system that filters and relays information to and from the cortex. This brain region is anatomically and functionally heterogeneous with different regions responsible for the various stages of instrumental task learning. For example, the ventral striatum (nucleus accumbens) is crucial for the initial stamping in of associations between stimulus and response during instrumental conditioning (acquisition), whereas the dorso-medial striatum (caudatus) is responsible for the subsequent weighing up of action versus potential outcome to establish policy for future action (action-outcome). In addition, the dorso-lateral striatum (putamen) pertains to stimulus-response associations, which are independent of outcome devaluation, are an artefact of overtraining and are often referred to as habitual responding. Stress and other factors, in the context of genotype, affect functioning of the basal ganglia in a range of species including the horse, primarily through alterations in dopaminergic modulation of the system. The behavioural side effects of these physiological changes have previously been associated with the stereotypy phenotype but also have important consequences for the learning profile of the animal. This paper presents the implications of these changes from a training perspective and discusses how dopaminergic tone and thus basal ganglia functionality can be potentially managed in the horse.

**LP:** Learning characteristics in animals are affected by changes in dopamine level in the brain and this may be practically important from an equine training perspective. Stress and other factors can cause changes in dopamine activity and the management of the horse should always strive to keep dopamine levels within normal physiological boundaries. These management factors include reduced level of stress during early development, meeting the behavioural needs of the horse as a species and avoiding highly palatable food stuffs.

## **Personality influences cognitive capacities in horses: synthesis of a series of experiments**

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Inter-individual variability in the expression of behaviour is a growing field of interest. A key factor to understand this variability is personality (temperament). A series of 7 experiments carried out on horses investigated whether certain types of personality promote cognitive abilities, especially instrumental learning performances. A model of personality has been developed in horse in our lab and permits to measure five independent dimensions with a series of behavioural tests. In these studies, stress, a key parameter that impacts learning performance, was manipulated. Low to moderate stress factors were used, corresponding to situations similar to those experienced by a horse at work (e.g. negative reinforcements or exposure to novel situations). The results show that if a horse was under stress at the time of learning, and if this stress was not caused by the learning situation itself (the horse was stressed prior to learning), the fearful horses were always disadvantaged (Valençon et al., PLoS ONE, 8(4), 2013). Nevertheless, being fearful was not always detrimental. When no additional stress was added, fearful horses had superior working memory performance, suggesting a higher state of arousal (Valençon et al., Anim. Behav. 1233-:1240, 2013). Furthermore, when the stress was induced by the task itself, for instance when using negative reinforcement, they also performed better (Lansade et al., Appl. Anim. Behav. Sci. 30:37, 2010). Finally, fearful horses have systematically been shown to be more resistant to extinction and are more prone to develop automatisms, suggesting a lower behavioural flexibility (Valençon et al., Anim. Cogn., 1001: 1006, 2013; Lansade L., et al., PLoS ONE 8(6), 2013; Lansade et al.a,b, in preparation). The other dimensions, such as gregariousness, activity or sensory sensitivity have a weaker influence on learning performances. Overall, this work helps us to determine the advantages and drawbacks of each horse and to suggest suitable tailor-made training programs for each individual.

**LP:** Among the different dimensions of personality, fearfulness seems to influence mostly the learning performances, but its influence is variable: generally positive in absence of stressor or when the cognitive task is the source of stress but negative in case of extrinsic stressors. We conclude that each kind of personality presents advantages or disadvantages depending on the learning conditions.

## **Communication through symbol use: a novel method to study horse preferences for blanketing**

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The aim of the project was to teach horses to use symbols to express their preferences regarding blanketing. Professional animal trainers carried out the ten step training program. Horses were trained for 10-15 minutes per day, 5-7 days a week. Using operant reward based conditioning horses were trained to approach and touch a board (35 x 35 cm) with the muzzle, firmly and without hesitation. Plasticity, i.e. independency of context and board position was ensured. Association learning between boards with different symbols, one meaning “blanket on” and another “blanket off”, and its consequence for blanket status after a touch, was initiated from day one. When the horse was confronted with two options, touching the meaningful symbol (e.g. “blanket off” if wearing a blanket) was encouraged and rewarded. Later, the third symbol meaning “no change” was introduced. Before approaching the most critical step, the transition to the free choice situation, the horse had to express meaningful symbol choices in 14 repetitions including challenges by heat and freeze tests. After transition to the free choice situation, no corrective influence was given by the trainers and any choice made by the horse was rewarded; options being “no change” and the meaningful blanket on/off symbol. Now, the horse was expected to understand that his free choice, as expressed by touching a specific symbol, determines the action of the handler regarding blanketing, and even understand the consequence in terms of thermal comfort the next hours. Till now, 23 horses, 13 cold-bloods and 10 warm-bloods of various breeds, age 3-16 years, have learned this task, accounting for 100% of the horses included. Speed of learning varied. Nevertheless, free choice could be introduced at day 11-13 (median 11) for all horses. The horses’ preferences were thereafter tested under differing weather conditions including sunshine, wind, rain/snow and temperatures ranging from -15 to +20 °C. Horses were left outdoors for two hours before given the choice to change, or not change, blanket status. Results reveal that the choices made by the horses were individually consistent but influenced by weather conditions. In general, cold-blood horses more often preferred to stay without a blanket compared to warm-bloods. Communication by the use of visual symbols is a promising tool for the study of preferences in horses.

**LP:** Horses can learn to understand the meaning of abstract symbols and to use these to communicate with humans. The preferred status regarding blanketing varies between individuals and is influenced by weather conditions.

## Foals' learning performance in four different learning tasks

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Several studies have suggested individual differences in the ability to learn, and that this individuality is task-dependent, i.e. different types of tasks may rank horses differently. This study aimed to investigate the performance of foals in four different types of learning tasks, targeting two motivation mechanisms. Twenty-one foals were tested in four different learning tests in 2013. The tests consisted of a clicker task (CT), a visual discrimination task (VD) and a spatial reversal task (SR), all based on positive reinforcement, and a pressure-response task (NR) based on negative reinforcement. In the NR task the foals had to learn to move laterally away from increasing pressure (0-30 N) applied by an algometer (ProD, TopCat Metrology Ltd) on the hindquarter. The VD test required the horses to learn within 10 trials that only one of two buckets, different in colour, shape and size, contained attractive food reward. The CT test required the horses to touch a target (green, square plastic lid) placed in four predetermined positions with their muzzle. A correct touch was rewarded with a click, immediately followed by a food reward. The SR test (only performed in 2014) required the horses to select the opposite bucket from that which had initially been trained. The foals were tested post-weaning (age: 30-50 weeks). They were tested in the four tests on two consecutive days (Day 1: NR and VD, Day 2: CT and SR). Preliminary results from the tested foals showed that the force required before the foals moved in the NR test, decreased over trials (slope:  $-0.67 \pm 0.19$ ;  $P < 0.0001$ ), suggesting that the foals learnt to avoid the increasing pressure of the algometer. In the CT test, three foals did not pass the initial shaping procedure within in the 10 min test time. The remaining 18 foals achieved between 7 and 63 clicks in the post-shaping procedure (mean $\pm$ s.e.:  $25.1 \pm 3.8$ ). In the VD test, only nine foals completed the 10 trials; the remaining 12 stopped responding. The nine foals completing the test made between 3 and 10 mistakes (mean $\pm$ s.e.:  $7.2 \pm 0.8$ ) during the 10 trials. There was no apparent change in the number of mistakes over the 10 trials ( $P = 0.42$ ). A suggestion for the unresponsiveness by the 12 foals could be lack of food motivation due to neophobia towards the food used. This problem has been taken into account in the experiments in 2014. Data from 2014 on a further 39 foals is currently being collected; collection will finish May 2014 and results will be presented.

**LP:** These preliminary results suggest that the pressure-response test and the clicker test worked well for investigating learning ability in foals and that 10 trials are not enough to learn to visually discriminate between two different buckets.

## **Social transmission of habituation from mares to foals**

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Early post-natal life is an important period for behavioural development, and the mammalian mother is of primary importance in the regulation of the offspring's behaviour. This study investigated whether mares can be used to modify fearfulness in foals via social transmission of object habituation. Twenty-two mare-foal pairs at two studs were included. Prior to foaling, all mares were habituated to five standardized fear-eliciting situations (including both tactile stimulation as well as stationary and moving objects) using desensitization and a combination of positive and negative reinforcement. At birth, the foals were assigned to either a DEMONSTRATION group (DEMO; n=11) or a CONTROL group (n=11), balanced according to stud, birth date and sex. One day per week during week 1-8 post-partum, mares of DEMO foals demonstrated their habituation to the five different situations (10 min/day) while the foal was loose in the test arena. Mares of foals in the CONTROL group were handled and fed the same amount inside the empty test arena with their foals (also 10 min/day). Subsequently, foals were tested at 8 weeks and 5 months of age in four standardized fear tests which either included objects that were present during demonstrations (NOT1), novel objects (NOT2), suddenness (SUD) or tactile stimulation (TAC). Behavioural and heart rate reactions were recorded. Between 8 weeks and 5 months of age, the foals were left on pasture with their mares. At 8 weeks, heart rates of DEMO foals were significantly lower in all four fear tests (t-test, HR max (bpm, mean $\pm$ se), e.g. NOT1: HAB: 85 $\pm$ 3.5 vs. CON: 124 $\pm$ 10.9; P=0.004 and NOT2: HAB: 82.1 $\pm$ 3.3 vs. CON: 106 $\pm$ 5.2, P=0.001). In addition, DEMO foals showed significantly reduced fear reactions and more exploratory behaviour in all tests, suggesting that the foals generalized their habituation to include novel objects. At 5 months, DEMO foals still showed reduced fear reactions, e.g. latency to walk across plastic (Kaplan-Meier Survival Analysis Log-Rank (mean survival time (sec)  $\pm$ se): DEMO: 35 $\pm$ 10.4 (9% censored) vs. CONTROL: 108 $\pm$ 9.4 (73% censored) P<0.001), whereas heart rates did not differ. The effect was probably achieved through a combination of maternal transmission of habituation and individual learning, since DEMO foals were free to interact with the training objects during the demonstrations. Interestingly, this stimulation early in life appeared to affect fear reactions also at 5 months of age.

**LP:** Fearfulness in horses is important to human safety and horse welfare. This study found that it was possible to reduce general fearfulness in foals through a combination of social transmission from the mare and individual learning early in life.

## **Objectivity in dressage judging: New horizons that arise from learning theory**

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'Shaping' is the scalar approximation of a precise response. It is widely accepted as an essential component in the translation of learning processes to training principles in trained species. In the equestrian dressage domain, it is important that judges are able to distinguish training successes and errors in a systematic and scalar way. It follows that if training is a result of a scalar shaping (ISES principle no. 3), then the analysis or judgement of training should be de-constructed with the same shaping scale. Despite recent attempts by the FEI to improve judging, this ambition is inhibited by traditional, subjective terminology and also by a judging scale, known as the German Training Scale, that is not scalar and which comprises a mixture of both subjective and objective elements. Outside the equestrian sphere, in sports where subjectivity also has the potential to pollute objective judging, for example gymnastics and diving, a judging revolution has occurred in order to objectify performances and justify results. Although dressage may be seen as more complicated than say, gymnastics, it is argued here that the difference arises more from the subjectivity and ambiguities that still haunt dressage coaching, training and judging. In this presentation, I propose to dissect the German Training Scale from the various viewpoints of a scientific appraisal of shaping, from identifying subjective as opposed to objective elements of that scale and in highlighting subjective, ambiguous and scientifically flawed terminology that interfere with the judging process. In the final part of the presentation, I introduce an alternative judging scale that arises from a more empirical approach to an analysis of trained responses and that can also be employed in basic form in all equestrian sports where judging involves an analysis of dimensional (wide-ranging) as well as categorical (discrete) qualities. This scale is peer-reviewed and evidenced-based, and comprises elements that are directly observable in all training endeavours. As a training scale it informs the training of a horse to walk a circle, lengthen the trot, perform a half-pass, pirouette or piaffe. It can also be used to load a horse in a trailer or other in-hand manoeuvres. In fact, every conceivable trained response in any species can be most efficiently achieved using this scale.

**LP:** Introduction of a new, objective training scale heralds a significant judging revolution in dressage and other horse sports. It will not only allow judging to become more accurate, fair and easy, but will also improve the welfare of the equine participants. This will ultimately contribute to the longevity of equestrian sports which is currently threatened in part by the lack of objective precision of contemporary judging guidelines at all levels.



## **“And now the ankle a bit further back”: Interaction analyses of trainers’ and riders’ work with horse-rider communication in dressage training**

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In the equestrian sports we agree that the communication between horse and rider forms the core of good riding. This communication is therefore often the main focus of for instance a dressage training session. However, in-depth analyses of *how* the communication between horse and rider is used as an educational resource in training are scarce. Here, theories and methods from communication and learning science are brought together to show how trainers and riders together address this communication during intermediate level dressage training. The results presented are based on a qualitative, mixed methods study, combining interactional analyses of 15 hrs of video recordings of dressage trainings and phenomenographic analysis of interviews with the participants. Analyses of the interviews show the complexity of these learning situations: the foci of the training sessions vary depending on the riders’ and the horses’ condition and the goals set up by the human participants as well as on the experience of the horse and the rider. Regardless of the didactical focus (on training the rider, training the rider to train the horse or training the horse) and the scope of the training session, the analyses of the video recordings show how all trainers orient towards the horse-rider interaction in essentially the same three ways. The trainers give verbal instructions aimed at modifying the horse-rider communication, they use their own bodies as models and they intervene physically by for instance altering the posture of the rider, the position of parts of the rider’s body or showing the correct degree of pressure to be applied in a certain situation (and combinations of the above). However, trainers do not always set the agenda for the discussions. When given the opportunity, many riders participate actively in the discussions. During the presentation, extracts from the video material will be used as illustrations of these findings. By enlightening the complex interaction between the participants as well as the interaction’s intrinsic connections to the goals of the training, it becomes possible to discuss (and further develop) the communication in the horse-rider-trainer triad within both the equestrian and the scientific communities.

**LP:** This study shows the communicative means trainers and riders use together to develop the rider’s communication with the horse and thus the performance of the equipage, depending on the individuals’ (both rider and horse) needs.

## **The effects of patting and wither scratching on behaviour and heart rate of domestic horses**

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Patting horses as a positive reinforcer is poorly researched and its origins unclear, despite being commonplace in equestrian culture. Anecdotal evidence and opinion suggest that patting is meaningless or even aversive to the horse. This study investigated the frequency of patting and its effect in a ridden situation (T1) and the effect of patting and wither scratching in a handling situation (T2). In T1, footage of 16 horse-rider pairs at the 2012 Olympics games, Grand Prix Special Dressage was analysed to collate information on timing, location of patting and subsequent behavioural reactions. Three riders interacted with their horses during the test and fifteen patted their horse on test completion, with twelve continuing patting for over 1 minute. A significant ( $P < 0.05$ ) percentage of pats resulted in a reaction, most commonly acceleration. Riders patted more on the right hand side of the horse (59%) than the left (22%) or both sides simultaneously (19%) ( $P < 0.01$ ). In T2, 5 frequently handled riding school horses (mean age 13.4 years) and 5 infrequently handled rescue horses (mean age 10.4 years) were patted or scratched for 4, 30 second intervals; separated by 15 second breaks. Tests were replicated using a cross over design. A control period consisted of the handler standing next to the horse. Horses were fitted with a polar heart rate monitor and their behaviour filmed for the duration of the test. Heart rate did not differ between treatments but unhandled subjects had a higher ( $P < 0.05$ ) overall heart rate and spent more time alert overall. For both groups behavioural reactions did not differ significantly from control. Patting resulted in more ear movement whereas head lowering was more commonly associated with scratching. Wither scratching also introduced new types of behaviour, mutual grooming and upper lip movement, which were not observed during control or patting treatment. This preliminary study indicates that although patting is frequently used during ridden work (T1), more positive behavioural responses were associated with wither scratching, when compared to patting in T2. Wither scratching could potentially increase horse/human bonding and act as a more effective reward. These results warrant further investigation with larger sample sizes.

**LP:** Riders and handlers frequently pat and scratch horses as a means of communication and to reward the horse. We found that patting was less effective than wither scratching, with the latter resulting in responses similar to those found in positive horse-horse interaction. Riders and handlers should be encouraged to scratch rather than pat their horses as a reward.

## **Linear personality and conformation trait evaluation system for horses shown in-hand: trait correlations and inter-observer reliability**

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The aim of the present study was to assess the suitability of a novel linear trait description method for assessment of both conformation and personality traits during presentation of horses in hand such as is the case in mare shows and stallion licensing. A total of 407 Trakehner mares were observed during mare shows. Besides their official evaluation via a grading system from 1 (very poor) to 10 (excellent), they were described by one judge for a total of 52 traits based on a linear scoring system adopted from the Dutch breeding association KWPN. With this system, traits are evaluated with scores from 1 (extreme and generally undesired expression of the trait; e.g. very short neck) to 9 (extreme and either desired or undesired expression of the trait; e.g. very long neck). Half (n=197) of the mares were simultaneously scored a second time by one of a total of 4 different observers. In addition to the conventional traits related to the gaits and conformation, a number of traits of particular importance to the Trakehner horse were evaluated. These traits included e.g. aspects related to beauty and personality (“attention” ranging from disinterested to very attentive and “calmness” ranging from very excited to very calm). Phenotypic correlations between similar traits evaluated conventionally and with the linear scoring system were generally as expected, i.e. positive with traits whose optima are at the extreme end of the linear scale (e.g. grade type – score head shape [*convex-concave*]:  $r=-0.71$ ;  $P<0.0001$ ), and non-significant with traits whose optima are equivalent to the intermediate expression of a trait (e.g. grade correctness walk – score straightness front leg movement [*toed in – toed out*]  $r=-0.03$ ;  $P=0.68$ ). Inter-observer reliability as calculated from variance components of a mixed model analysis was generally in an acceptable range, also for the novel personality traits (attention:  $0.68\pm0.04$ ; calmness:  $0.60\pm0.05$ ). These findings indicate some aspects of personality may also be evaluated reliably in-hand without the use of a specialized test. Considering these results together with the fact that with the conventional system, horses with contrasting expressions of a trait (e.g. toed in and toed out) may receive the same grade (e.g. 6), it is suggested that the linear scoring system more accurately reflects the assumed linear genetic basis of traits. Therefore, a greater genetic gain in both conformation and personality traits is to be expected, when linear rather than grade-based evaluation system is used.

**LP:** Reliable personality trait evaluation appears to be possible for some traits also without use of a specialized test during presentation of horses in hand, e.g. during mare shows.

## Protocols for research in equitation science

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Within the emerging discipline of Equitation Science, the application of consistent methodology and robust objective measures is necessary to fulfil the criteria of sound scientific evaluation. This report aims to provide an evaluation of current methodology and to set out some initial guidelines for future research in this area. The value of research findings, often from studies involving small sample sizes, will be enhanced by the application of consistent methodology and reporting. This will enable results to be compared and pooled as appropriate. To this end, this report includes guidelines on features of experimental design in studies involving the ridden horse. This includes general guidelines to be followed when designing studies involving horses and riders as well as a list of variables to be reported when conducting studies, regardless of what is being measured. More specifically, guidelines for collecting behavioural and physiological data from the horse are provided. These include a review of current equine ethograms and factors to consider in the development of a ridden horse ethogram. To allow accurate interpretation of behavioural signs, concurrent physiological measures are often taken. An evaluation of methods used to collect this supporting physiological data with recommendations for application and subsequent reporting of results is included. An evaluation of current equipment used to assess human-horse interactions in ridden situations (rein tension and pressure sensing instruments) and the reporting requirements of studies utilizing such equipment is also included. Within this new discipline there are inevitably a number of issues to be resolved in terms of research design, some of which are discussed in this report. Although ongoing technological advances have the potential to improve the accuracy and detail of measurements that can be taken, without consistency of experimental design and the inclusion of sufficient detail relating to the sample concerned, the value of this data may be reduced. The guidelines included in this report are based on findings to date from research involving ridden horses in a range of studies. It is anticipated that these guidelines will evolve with the advent of new technology.

**LP:** This is the ISES' first attempt to explore a system for standardising the methods we use to obtain data. It is hoped that, in the future, standardised protocols will allow us to pool data.

## **Riding and road safety: building profiles of leisure riders and their environment in the United Kingdom**

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Research into road safety for the leisure rider has reported that certain measures can be taken to decrease the incidence of near misses (NM) with traffic for horse and rider using the UK road network. These include the rider wearing lights, education of other road users and practical use of fluorescent/reflective (FR) equipment. This study aimed to investigate the factors that might affect incidences of NM in order to build a safer rider profile that could be followed by those who use the road networks. An extensive questionnaire was distributed via UK social media sites and was completed by 353 riders to determine if particular conditions may increase the likelihood of NM occurring. The questionnaires covered the wearing of FR equipment, horse colour, demographic information and the environment where NM occurred. Horse colour was divided into solid (block) colour and piebald/skewbald (broken) colour. Occurrences of NM were also allocated a season of the year and time of day. 66.2% of riders had experienced a NM with traffic in the last year. There was no significant relationship between rider and horse combinations wearing FR equipment or not and incidence of NM ( $\chi^2_1=0.01$ ;  $P>0.05$ ). There was no significant relationship between the wearing of FR equipment and the incidence of NM for neither horse nor rider ( $\chi^2_1=0.01$ ;  $P>0.05$  and  $\chi^2_1=0.04$ ;  $P>0.05$ , respectively). Location was not a determinant of likelihood of NM happening ( $\chi^2_1=0.96$ ;  $P>0.05$ ). NM were significantly more likely to occur in summer ( $\chi^2_3=137.43$ ;  $P<0.05$ ) and also in the early morning ( $\chi^2_4=30.32$ ;  $P<0.05$ ), although there was no significant difference in occurring NM when time of day and season were compared ( $\chi^2_2=3.53$ ;  $P>0.05$ ). However, riders wearing lights resulted in significantly less incidences of NM ( $\chi^2_4=37.64$ ;  $P<0.05$ ). Additionally, horses of broken colour experienced significantly less NM than horses of block colour ( $\chi^2_1=4.66$ ;  $P<0.05$ ). The selection of broken coloured horses by the leisure rider for riding on the road network may well give an advantage of safety over the choice of other coat colours, as does the addition of lights to the FR equipment worn.

**LP:** Horses with a piebald or skewbald coloured coat are reported to have noticeably less NM than horses of solid colours, as do those rider and horse combinations that wear lights. Combinations who do wear FR equipment do not seem to have any advantage in avoiding NM than those who do not. It is possible that the selection of coloured horses for the leisure rider may prove safer when considering their use for riding on the UK road system.

## **Bridging the Gap: Embedding the science into teaching and practice**

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There is an increasing recognition of the importance of the integration of underpinning scientific principles of learning in equitation and recognition that this can both enhance the performance and improve the welfare of competition horses. Two aspects of the emerging discipline of Equitation Science (ES) are crucial for improvement of equine welfare; firstly, the underpinning of both horse and human interactions with an understanding of equine ethology and learning theory and, secondly, the use of measurements and innovative technology to provide objective data to support the practical application of ES. Barriers to progress for ES are that scientists and practitioners tend to occupy different cultures with each group using a different technical language, leading to confusion and lack of uptake. For example, equitation and veterinary practitioners may not necessarily understand the tools, terms and methodologies used in equitation science research. Tertiary level Equitation Science education is therefore essential if we are to produce future professionals capable of encouraging sound ethical, evidence based practice within the equine sector. The veterinary profession is a key stakeholder and in order to bridge the gap between theory and practical application it is essential that we find ways to encourage dissemination of good practice, through knowledge transfer within both the classroom and the clinic. In this paper we will explore the way in which ES is currently being integrated into the RDSVS undergraduate and post-graduate curriculum and modelled through the behaviour of veterinarians working in the clinical practice areas.

**LP:** Equitation Science needs to be accessible if it is to become mainstream. Education is a key to breaking down barriers related to the scientific terms and lack of transfer of theory into practical contexts. Integration of equitation science theory within veterinary training has huge implications for equine welfare. The authors will show how this has been achieved at the RDSVS in Edinburgh.

## **Sustainable training and riding: Preparing horses for sportive activities**

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An argument used for decades to justify research on horses used for sports was to seek measures to reduce their injury rate, pain and discomfort due to the sportive activities. However, by experience, I learned that this is unlikely to be achieved no matter how many effective physical exercises we will find to condition horses better. One reason is that the subject is multifaceted! Another reason is that when a horse (seemingly) is doing well – offers to work – it will be competed because there is not much practical information on parameters that would indicate early that horses need to be rested from strenuous exercise and competition. A further obstacle is the widespread opinion that the horse is an innate athlete. This holds in some regards comparing the horse with other species, but it is entirely irrelevant for the matter because sport horses compete against sport horses only and under conditions that can be harmful without meant to be so, if it is not sufficiently well prepared for the demands. Thus, obviously it would be better to train them. However, all data on the practice of conditioning horses indicate that it is unlikely that this is done sufficiently. From the many aspects involved in keeping sport horses sound and comfortable I will address four only: 1) Fitness of riders: Riders should work on their own fitness including gymnastics to maintain their horses healthy and themselves, too. 2) Riding ability: The riding ability is notably impacted by the fitness of riders, but their riding skills also impact the health and comfort of horses. 3) Time devoted for conditioning: Sports science knowledge makes anachronistic the current practice of exercising horses in sessions of less than 60 minutes/day (I do not consider the activity of horses in most horse walkers as an exercise session). This management routine is not driven by the physiological or psychological needs of horses but economics and organisation of labour. 4) Individualized conditioning: Several exercises other than the ones used in practice have been found to improve fitness of horses but these dictate exercising horses at individualized levels of intensity and imply new forms of organising work at racetracks and riding establishments.

**LP:** Sustainable training and riding can be achieved to some extent but would need marked changes in the way we manage horses in practice nowadays. The plenary raises several points for debate regarding the way sports horses are trained and used today.

## Exercised-induced cardiac changes in the equine athlete

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Prolonged physical exercise induces dramatic changes in the body. With increased oxygen demands during exercise the demand for blood flow is met by increased stroke volume and increased heart rate, resulting in increased cardiac output. For the short-term, the heart can easily cope with the greater volume and/or pressure loads. However, when the overload is repeated over time, other mechanisms become activated, leading to an increase in cardiac muscle mass. This physiological phenomenon is described as the “Athlete’s heart”. There has been considerable scientific debate over the years whether large hearts in horses are associated with racing success. The rationale behind this hypothesis is that stroke volume is increased in athletes with a larger heart and maximum oxygen uptake ( $V_{O_{2max}}$ ) will increase, which has been documented in Thoroughbreds. These results support the findings in studies of racehorses demonstrating a positive relationship between heart sizes and racing performance. In addition to cardiac hypertrophy, equine athletes develop valvular regurgitations (leaking cardiac valves which are heard as cardiac murmurs). The physiological explanation for the development of valvular regurgitations is unclear, but in general these regurgitations are small and do not increase in severity over time. Moreover, it has been shown that the majority tends to disappear after exercise. Exercise-induced cardiac changes also result in cardiac arrhythmias. Studies of arrhythmias in normal performing racehorses and riding horses have been published recently and quite high amounts of cardiac arrhythmias are observed. Interestingly, it seems that show jumping horses develop relatively more ventricular arrhythmias during jumping compared to other disciplines. An explanation could be the substantial HR fluctuations during jumping. The significance of these arrhythmias remains to be clarified. High performance horses are at risk of dying from cardiac failure while performing at maximum capacity; and horses have collapsed and died during or after exercise. The pathophysiological changes underlying collapse or sudden cardiac death in horses are unknown. Sudden death of horses has a big impact on animal welfare, rider safety, finances and public relations. Most horses that suddenly die do not show sufficient lesions to account for death on necropsy. As spontaneous arrhythmias are common in the exercising horse it can be speculated that cardiac repolarization disorders may be responsible for sudden death as described in humans, but this area needs to be elucidated further.

**LP:** Well trained horses will over time develop a larger heart, mild low-grade cardiac murmurs and most likely some cardiac arrhythmias during and after exercise – all characteristic for Athlete’s Heart. Whether these changes could lead to potential fatal arrhythmias and sudden death in equine athletes remains speculation.



## **Activity patterns of trunk muscles in walk, trot and canter and their relation to different head-and neck-positions**

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The activity patterns of trunk muscles are commonly neglected, in spite of their importance for maintaining body shape. Analysis of the biomechanics of the trunk under static conditions has led to predictions of the activity patterns. These hypotheses are tested experimentally by surface electromyography (EMG). In addition, the influence of three HNPs (head-and neck-positions) on the statics of the trunk was evaluated. Five horses, with and without a rider, were examined in common gaits in three different HNPs: a “free”, a “gathered” (head higher, neck more flexed with the noseline in front of the vertical) and a “hyperflexed” position. Footfall was synchronised with EMG by an accelerometer. Averages of ten consecutive cycles were calculated and compared by statistical methods. The start and stop times of the muscle activities of 5-10 undisturbed EMG-plots were determined and the averages and standard deviations calculated. In walking, muscle activities are minor. EMG-activity was increased in the m. rectus during the 3limb-support. When the bending moments assume their greatest values, e.g. while the horses’ mass is accelerated upward (2 times earth acceleration) in the diagonal support phases in trot and canter the m. rectus, connecting the sternum with the pubic bone is most active. The m. obl. externus is most active when the torsional and bending moments are greatest during the same support phases, but not bilaterally, because the forces exerted on one side by the (recorded) m. obl. externus are transmitted on the other side by the (not recorded) m. obl. internus. While the hindlegs touch the ground in the trot and canter, ground reaction forces tend to flex the hip joint and the lumbar spine. Therefore, the vertebral column needs to be stabilised by the ipsilateral m. longissimus dorsi, which in fact can be observed. The examined HNPs influenced the muscles of the trunk less than those of the neck. The differences vary with gait and with HNP in a way difficult to understand and to summarize. The m. rectus abd. is in the free position in trot and canter and in the gathered position in canter ( $P < 0.01$ ) more active than in the hyperflexed position. The m. obliquus shows lower activity in the gathered position than in the free and hyperflexed positions ( $P < 0.05$ ). The m. longissimus shows in walk in hyperflexion higher activity than the free position ( $P = 0.004$ ). In trot, the free position leads to higher muscle activities than the gathered position ( $P = 0.042$ ).

**LP:** The EMG-activities of the trunk muscles are in agreement with what has been predicted by biomechanical analysis. The mass of the rider exerts little influence on muscle activity. The position of head and neck is not clearly reflected in the EMG-activities of the trunk muscles.

## **Risk factors for horse falls in the cross-country phase of one day events**

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Eventing is well recognised as a high risk sport, associated with higher levels of fatalities and serious injuries than other “dangerous” sports like motorsport and rugby. Understanding the most common causes and risk factors for cross country falls may help the industry implement preventative measures. The purpose of the study was to identify any significant risk factors associated with horse falls and to establish a spectator and rider view of the main concerns with safety in eventing. Data were collected from 2,002 horse and rider combinations in the Novice, Intermediate and Advanced levels of 37 randomly selected British Eventing one-day event competitions from 2003-2012. Binary logistic regression was used to examine the influence of competition level, horse age and gender, rider gender, position before cross country, month and year, and event on the probability of a horse fall. A self-administered online questionnaire was used to collect rider and spectator perspectives on eventing horse falls. The questions covered the participants’ experiences of falls, either as a rider or spectator, and their opinions of the causes of horse falls and suggestions for safety improvements. Falls occurred in 4.78% of cross country starts (96 falls, number of starts=2,002). Position before the cross country was found to be the only significant predictor of horse falls ( $G=4.219$ ;  $P<0.05$ ). Competitors in a top three position before cross country were significantly more likely to have a horse fall than any other position ( $P<0.05$ ). For example, riders in position 4-10 were 0.49 times less likely to have a fall than those in positions 1-3. Of questionnaire respondents ( $n=131$ : 61.83% riders, 29.77% spectators, 8.40% neither competitor nor spectator), 74.05% stated the main risk factor for a horse fall is rider error, followed closely by rider inexperience (64.88%). Speed was also identified as a key risk by respondents. Riders were significantly more likely to attribute horse falls to rider error than spectators ( $\chi^2_2=9.490$ ,  $P<0.01$ ). The study has identified that position before cross country is a significant risk factor associated with horse falls during competition. Riders in a more competitive position upon commencement of the cross country may have a tendency to take more risks or ride in a faster or more intense manner. Improved rider skill and understanding may be an approach to help reduce risks of falls in the future. It could also be considered whether placings should be concealed until after the cross country phase.

**LP:** Horse and rider combinations in leading positions at the start of cross country are at greater risk of falls. Improved rider skill and understanding may help to reduce risks faced by horse and rider.

## **Health of riding school horses in Denmark: Questionnaire survey of management and incidence of clinical disease**

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The aims were to investigate the riding school management and the incidence of clinical disease in the school horses. The survey of management was based on telephone conducted structured interviews. Three riding schools were pilot studied with focus group interviews about physical facilities, daily management, staff education and responsibilities, riding programs and riding equipment, the general horse day cycle and disease occurrence. On this basis, a final structured questionnaire including 44 questions was developed. A diary was developed for daily recording for each horse of working hours, free time and hours on pasture, absence due to disease and recording of clinical disease. Riding schools were initially contacted through the Danish Riding Association (Dansk Rideforbund) with 462 member schools. Based on a Facebook invitation, 49 riding schools volunteered to be telephone interviewed and 20 of these volunteered for daily recording for each horse during 4 months (March – June 2014). To evaluate the representativeness of the volunteers, 51 other Danish schools were randomly selected for an interview. So far, 85 schools have been telephone interviewed. Thus, data collection is on-going. Examples of preliminary descriptive results based on 85 riding schools show that the most common causes for a horse to be excluded from riding lessons were due to lameness (57 schools), colic (10 schools) and behaviour problems (1 school). Ten schools had no dominating problem. The two major reasons for culling (selling or slaughtering) horses were behavioural problems (70 schools) and lameness (45 schools). The range of disease days was 1-30 due to lameness and 1-7 days due to colic and behaviour problems. The horses worked 1-4 hours per day. The horses were either in loose housing (11 schools) or in boxes (69 schools). The horse age at purchase was generally >7 years but with large variation. Horses were on average kept at the school for 8 years (range 1-18). The teacher average age was 41 years with average 11 years of teaching experience. The range of riding school sizes was 3-48 horses and 12-450 riding students. Disease recording in 3 schools showed incidence rates varying from zero (no disease recorded) to 3.3 cases of disease per 100 horse days at risk during a two-week observation period in March 2014. An already completed literature review shows there is very limited information on this topic. At the time of the conference the data collection and analysis will be completed, and many results will be presented.

**LP:** The project will give new knowledge about riding school management, training of students, and frequency and risk factors for disease occurrence in riding horses.

## The unshod horse: A competitive disadvantage in dressage?

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Current literature shows that shoeing improves gait quality but at the risk of increasing concussion to the limbs. To make an informed decision on whether to shoe or not, it is important to quantify if the benefit is worth the risk. This was the first study to compare the kinematics of horses that had been conditioned to being either shod or unshod for at least the previous 12 months, thereby looking at the practical implications for performance. The highly significant increases in joint flexion associated with being shod seen in previous studies using non-conditioned horses could not be replicated. Twenty adult Irish Sport Horses used for a range of activities from general riding up to British Dressage Novice dressage (10 shod and 10 unshod) aged  $13\pm 3$  years, height  $164\pm 5$  cm and weight  $519\pm 34$  kg were recorded in trot in hand on a non-waxed fibre/sand arena surface using a high-speed video camera (120 fps) and compared using Kinovea™ gait analysis software. The differences between the two conditions were assessed against 5 previously determined kinematic criteria for gait quality (stride duration, fetlock extension, scapular rotation, elbow flexion and carpal flexion). Additional stride parameters of speed, stride length, maximum hoof vertical displacement and swing duration were also compared, again using Kinovea™ gait analysis software. Each data set was found to be parametric using the Shapiro-Wilk test for normality and was then compared for significance using a 2-tailed independent t-test. Although there was a general trend towards greater joint flexion in the shod horses, the only highly significant differences ( $P<0.001$ ) were carpal flexion ( $71\pm 2^\circ$  unshod compared to  $79\pm 4^\circ$  shod) and maximum hoof vertical displacement ( $15\pm 4$  cm unshod compared to  $21\pm 4$  cm shod). The key dressage performance related indicators of stride duration, fetlock extension, scapular rotation and elbow flexion showed no significant differences according to foot treatment. Stride length was significantly reduced ( $P<0.05$ ) with the shod sample ( $2.67\pm 0.10$  m unshod compared to  $2.59\pm 0.10$  m shod). It was postulated that horses become habituated to the additional weight of shoes which, over time, reduces the initial effects that previous studies have recorded within 1-3 days of being shod for the first time. Having worn shoes for at least 12 months, shod horses did not display a significant difference in 4 of the 5 kinematic variables that correlate best with dressage marks and were therefore viewed as not having a competitive advantage when compared to their unshod counterparts.

**LP:** The performance of a dressage horse is unlikely to be affected by the choice of being either shod or unshod. This is in contrast to the widely held belief that shoeing improves gait quality.

## Rein tension used by riders during regular riding sessions

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Though several studies have investigated rein tension during riding there is information deficit of rein tension relative to gaits and exercises, as well as of between-rider and between-horse effects. The aim of this study was to examine the rein tension employed by professional riders, riding horses in their own training during regular and preferred riding sessions. Eight professional riders each rode 3 horses in their own training, asked to demonstrate their normal routine for dressage, each rider determining the session lengths. Training sessions were video recorded (25Hz). The horses were fitted with a custom-developed rein tension meter (128Hz), measuring range 0-500N, where data acquisition was made through an inertial measurement unit (IMU) fastened on the horse's browband. Gaits and exercises were classified from the video by one observer and validated from the IMU acceleration signal. The rein tension was determined at walk, trot, left and right canter for each rein. Reins were defined as dominant versus non-dominant. 'Dominant' was the right rein in right handed riders and the left rein in one left-handed rider. Mixed models analysis was used to study data on short reins, median 1) dominant and 2) non-dominant log-transformed rein tension, including gait (walk, trot, left canter and right canter) and whether horses worked straight or bent (corners, circles, halfpass, shoulder-in), including the 2-way interaction. 'Horses within rider' was a random effect. The mean duration of the riding sessions was 32 (STD 6) min. Of the time 69% was on short reins. In total, 36% of the time was in walk, 35% in trot and 20% in canter (51%/49% left/right canter). Median rein tension in walk was 9N/7N for the dominant/non-dominant rein, in trot 14N/14N, in left canter 19N/20N and right canter 20N/19N. The gait and exercise interactions were significant ( $P < 0.0001$ ). In total, 39 of 67 pair-wise comparisons were significant for the dominant rein, and 29 of 67 for the non-dominant rein. Ignoring comparisons between gaits, we note there were no significant differences between different exercises within trot, while there were 4 significant differences between exercises within canter ( $P < 0.03$ , left and right canter compared as one gait) and 4 within walk ( $P < 0.0001$ ). For walk, the right bend had the highest median rein tension for both reins ( $P < 0.0001$  compared to left bend and straight). For both models the variation introduced by horses within riders was 65%.

**LP:** Rein tension differences were found between gaits and riders, but we also found differences between exercises within gait. Awareness of this may increase the understanding of how to use the rein from both a welfare point of view and for achieving a successful sport horse.

## Is elastic fantastic? The impact of elastic inserts on rein tension

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There is an industry wide interest in developing horse equipment to enhance riding and training practices. Elastic has been used over the years to achieve ‘give’ in and flexibility in equipment such as girths and reins. Sustainable and ethical equitation relies upon the effective delivery and receipt of clear signals and timely pressure-release. This study aimed to determine the effect of elastic insert in reins on first, the tension applied for normal riding and a walk to halt transition, and second, the ability to release the tension in the reins. Thirty regular riders ( $\geq 4$  times/week), all female, average age  $22 \pm 3.87$  years, participated in this study. The Centaur Rein Tension Gauge™ was fitted to a fixed structure and reins with elastic insert or standard rubber reins were attached. Both sets of reins measured 20 mm x 6 mm (width x depth) and weighed 350 g. Rein tensions (N) were measured for left and right hands, both rein types when taking up a normal riding contact and executing a walk to halt transition using a cross-over design. The time (s) for a total release of tension was also derived for each rein type. There were three replicates for each rein type. Significantly different tensions were observed between the two types of rein ( $F_{1,16}=5.54$ ;  $P<0.05$ ). Lower tensions were exerted with the elastic insert ( $3.33 \pm 1.97$ N) than with the rigid reins ( $5.83 \pm 1.17$ N) in the normal riding contact condition, whilst higher tensions were evident with elastic insert reins ( $21.3 \pm 6.19$ N) than with rigid reins ( $15.8 \pm 4.4$ N) in the walk to halt transition. The time taken for rein tension to return to zero following complete release from a set value of 25N was significantly greater and less consistent with the elastic insert reins ( $F_{1,8}=5.05$ ;  $P<0.05$ ;  $3.85 \pm 3.22$ s) than with the rigid reins ( $0.53 \pm 0.27$ s). This study suggests that although elastic inserts in reins may result in less tension in general riding, they may alter riders’ behaviour in terms of the tension applied when executing a particular equitation task. Furthermore, elastic inserts in reins may have a deleterious effect on a rider’s ability to apply negative reinforcement accurately and therefore clarity during training.

**LP:** Rein design which includes elastic can have a substantial impact on the tensions applied particularly when making transitions during equitation. The impaired ability to simultaneously release pressure may have a negative impact on equine learning and training, and consequently equid stress and welfare.

## The influence of rider handedness on rider position

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Riders learn early in their riding career that the ideal riding position shows vertical alignment through the rider's ear-shoulder-hip-heel with equal weight distribution on both seat bones. Without the correct position, riders cannot give the aids correctly which in turn affect performance. Lateral dominance may affect the symmetry of a rider's position and hence impair clear communication with the horse. The aim of this study is to determine if a correlation exists between the rider laterality and rider symmetry. A survey was completed by 25 female riders (18 right-handed, 7 left-handed) to collect demographic information and information on their riding discipline, level and frequency. Each rider was videoed riding her own horse with markers affixed both to ears, shoulders, hips, knees and ankles. Sixty still frames/gait/rider were captured from videos taken from both left and right sides and the rear while riding in a straight line at the halt, walk, trot and canter. Rider symmetry was determined by measuring the angle of displacement of a horizontal line drawn through the rider's ears, shoulders, hips, knees and ankles from a vertical reference line. To account for the crookedness of the horse, the displacement of the horse's spine in relation to the rider's spine when viewed from the rear was used as a covariate in a mixed model analysis, with dominant hand, riding discipline, level of the rider and gait as fixed factors and rider as a random factor. Paired t-tests compared rider symmetry on left and right sides, and independent t-tests compared overall riding position for left and right-handed riders. At the halt, the position of all riders was very close to the ideal ( $P > 0.20$ ). All riders differed in their head, leg, knee and chest positions on the left versus the right side ( $P < 0.011$ ). Beginner riders leaned more forward than advanced riders ( $10^\circ$  vs.  $4^\circ$ , respectively;  $P < 0.011$ ). Right-handed riders leaned more forward ( $P < 0.002$ ), tilted their head to the right ( $P < 0.0001$ ), twisted their torso to the right ( $P < 0.002$ ), carried their legs more forward ( $P < 0.005$ ) and had a more open knee angle ( $P < 0.028$ ) whereas left-handed riders tipped their head more forward ( $P < 0.0001$ ), and pushed their right heel down farther ( $P < 0.04$ ). Thus, handedness does appear to affect rider position.

**LP:** While all riders can achieve almost ideal riding position at the halt, increasing movement of the horse alters rider symmetry. Right-handed riders lean more forward and carry their legs farther forward. Riding position of left-handed riders is closer to the ideal ear-shoulder-hip-heel alignment. Awareness of riding position can help riders and coaches improve communication to prevent inappropriate signalling that could lead to confusion in the horse and conflicting corrections from the rider.

## **A Preliminary Investigation of Horses' Preference for Different Ammonia Concentrations**

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Ammonia (NH<sub>3</sub>) is harmful to human and animal health. Previous research has demonstrated that both horses and their owners could be exposed to high levels of NH<sub>3</sub> in the stable environment. Preference for different NH<sub>3</sub> concentrations has been investigated to some extent with other livestock species, but has not been determined in horses. The objective of this pilot study was to develop a preference test to investigate the effects of NH<sub>3</sub> concentration on horse behaviour and welfare. To test the preference of horses to different NH<sub>3</sub> concentrations, a head box system consisting of two wood frame head boxes with gas flow control and a PC-based data recording system was used. The dimensions of each head box were 50.8 cm W x 50.8 cm D x 76.2 cm H. Head boxes were placed in a 4.3 m x 4.9 m stall and each box was equipped with a 38.1 cm x 38.1 cm x 15.2 cm square feeding pan containing an equal amount of an equine senior concentrate. Following initial acclimation to the head boxes, seven adult horses of different breeds (4 geldings, 3 mares) performed a two-choice preference test in which they could select to feed from either 0 ppm or 25 ppm of NH<sub>3</sub>. Testing consisted of a single, 10 minute trial across two days to eliminate directional bias. During each trial, initial head box selection, feed consumption and heart rate (HR) were recorded. Trials were video recorded to note responses and derive behavioural measures that may serve as indicators of aversion. Preference was measured as intake from the 25 ppm head box expressed as a percentage of total feed intake. Statistical analysis was performed using Student's t-test (JMP 10). On Days 1 and 2, six of the seven horses chose the closest head-box from the release point. On Days 1 and 2, the feed consumption from the 25 ppm head-box, expressed as per cent intake of total feed offered, did not differ from the 0 ppm head-box ( $P=0.3757$  and  $P=0.1134$ , respectively). On Day 1, preference for 25 ppm was 57.91% which was not different from 50% ( $P=0.2509$ ). On Day 2, preference for 25 ppm was 17.68% which was significantly lower than 50% ( $P<0.006$ ). Initial and final HR (mean $\pm$ SEM) during testing were 64.57 $\pm$ 5.08 and 51.14 $\pm$ 3.26, respectively. Behavioural analysis from video recordings and analysis of correlations between behaviour and HR are pending. The head box system shows promise as a research tool for investigating the effects of air quality on horse behaviour and welfare.

**LP:** Preferences between fresh and ammonia filled air have not been studied in horses. If horses demonstrate aversion to ammonia, then in addition to being a health concern, high ammonia levels in the stable may constitute a source of discomfort and stress for horses.



## Nordic winter weather and horse thermoregulation

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The aim of this study was to investigate the effects of different winter weather conditions on shelter seeking behaviour of horses and their preference for additional heat. A total of 17 horses of different breeds were habituated to an experimental paddock with a double-room shelter (measuring 3.3 x 3 m per room). In one of the rooms, a 1500 W infrared heater provided radiation heat, the other room was not heated. Every test day, horses were turned out in their regular paddocks for two hours (without rugs or blankets) and then moved to the experimental paddock. There, horses could choose between the heated room, the non-heated room or to stay outside in the 11 x 11 m paddock. Using instantaneous sampling at one-minute intervals for one hour, an observer recorded horse's individual behaviour and location (outdoors, in heated room, in non-heated room). All horses were tested on several days, under different winter weather conditions – functioning as their own control. Weather data were recorded continuously using a professional weather station (ITAS). Kruskal-Wallis and a GLM tests were performed on the preliminary data. Muscle shivering was only observed during mild weather ( $\geq 0^{\circ}\text{C}$ ) and rain, and more horses chose to visit the shelter in this weather ( $X^2=7.9$ ;  $P<0.05$ ). Small warm-blood horses used the shelter to a greater extent than small cold-blood horses ( $F_{4,69}=4.1$ ;  $P<0.01$ ). Horses with a low coat sample weight used the shelter more than horses with a large coat sample weight ( $F_{2,71}=7.0$ ;  $P<0.01$ ). When outdoors, individuals with a low body condition score spent more time standing passively than individuals with a large body condition score ( $F_{4,69}=4.4$ ;  $P<0.01$ ). In conclusion, not only the horses breed but its body condition and coat characteristics affect thermoregulation related behaviour during winter weather.

**LP:** Low temperatures down to  $-7^{\circ}\text{C}$  had no negative effects on horse behaviour and welfare. The most challenging winter weather for horses is rain or sleet where the horse becomes wet. During such weather conditions, the horses preferred access to shelter. Shelters give the horse the opportunity to regulate its heat loss to the environment during shifting weather conditions. The need for blankets or shelter should be assessed for each individual horse and not only based on breed and common practice.

## Blanketing and clipping practices among Swedish horse owners

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Little information is available on the frequency of blanketing and clipping practices among horse owners, the underlying motivations, their relation to the management of the horse and seasonal variations. The objective of this study was to collect quantitative data on the blanketing and clipping routines undertaken by horse owners in Sweden. An internet survey was designed and distributed via social media, gathering information on owner and horse demographics, management of the horse and clipping and blanketing routines. Besides descriptive statistics, correlations between variables were analysed with Spearman's rho. After a two-week sampling period, answers from 3686 respondents were analysed, representative of Sweden's 21 counties. Ninety-one per cent of respondents use blankets during turnout, especially during cold temperatures, strong wind and precipitation (52%). Blanketing was significantly correlated with breed (Warm-blood riding horse 97%,  $r=0.21$ ; Icelandic horse 74%,  $r=-0.23$ ; Cold-blood riding horse 83%,  $r=-0.75$ ;  $P<0.01$ ) and equestrian activity (dressage 98%,  $r=0.17$ ; show-jumping 99%,  $r=0.15$ ; eventing 98%,  $r=0.04$ ; carriage driving 71%,  $r=-0.16$ ; Icelandic horse riding 75%,  $r=-0.02$ ; breeding 78%,  $r=-0.12$ ;  $P<0.05$ ). Seventy-four per cent reported using blankets in the stable. Blankets are also used during transport (72%) and training (warm-up/cooling down 35%) mainly in autumn and winter. Clipping was practiced by 69% of respondents (highest number among show-jumping 88%) whereby removing the entire coat except on head and legs was most common (40%). The majority of respondents clip to shorten drying time of the sweaty coat after exercise (63%) and to improve performance (37%). Results suggest that blanketing and clipping are widely applied in practice. Differences related to horse breed, equestrian activity and housing conditions were detected. This information can be used to develop targeted research on the effects of blanketing and clipping on horses' thermoregulation and welfare.

**LP:** Given the widespread use of blankets and coat clipping, owners are encouraged to consider the relevance of these practices from the horses' point of view, taking into consideration the type of work the horse is exposed to and its general management, including housing.

## A comparison of methods to determine equine laterality

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The study aimed at comparing agreement between results obtained by different methods to determine equine laterality. Three groups of warm-blood horses (n=67, age 0.25–23 years) were classified according to their preferred advanced foreleg during grazing (scan sampling at 30 or 60 second intervals for 2 hours), lateral displacement of their hindquarters in relation to the median plane, visual laterality and preferred side specified by their riders. Cross-tabulations of two characteristics with 2-5 values were investigated for random distribution using chi-square tests, phi and Cramer's-V in SPSS. In a 30 second scan sampling 11 horses tended towards leg preference (z-value  $>\pm 1$ ). Significant (z-value  $>\pm 1.96$ ) leg preference was detected in 6 horses. Results changed considerably with the 60 second sampling: leg preference and associated significance levels remained, increased or decreased between both samples but never changed direction ( $P < 0.001$ ). The majority of horses were not ridden. Most ridden horses with their hindquarters displaced to the right (n=14) were classified as right-lateralised by their riders. Some, however, were described as left-lateralised. Riders classified all horses with their hindquarters displaced to the left (n=7) as left-lateralised ( $P = 0.003$ ). Right-lateralised horses did not show a significant leg preference. Some, however, tended to prefer their left (14.3%) or right leg (7.1%). Left-lateralised horses tended to or significantly preferred their left leg (28.6%) or showed no preference (71.2%) (60 second interval,  $P = 0.018$ ). During frontal approach with objects (plastic bag, toy, ball), most horses did not prefer any eye (80-88%). Except for one horse, only left sensory bias was detected. Left-eye preference was observed only in horses with a left-leg or no preference ( $P = 0.005/0.009$ ). The preferred left foreleg during grazing seems to correlate with preference of the left eye and left side during riding. However, this does not apply to horses preferring the right leg. The displacement of the hindquarters correlates with laterality during riding in all left, but not all right-lateralised horses. Motor bias during grazing seems to be accurate according to the direction, but not the degree or actual occurrence. Thus, the agreement between different aspects of laterality in horses seems to be limited to specific measures and outcomes. Attention should be paid to the desired information when selecting methods for assessment of laterality.

**LP:** Laterality in horses can be more accurately determined in left-lateralised horses. The displacement of the hindquarters indicates the preferred side during riding for left-, but not all right-lateralised horses. Leg preference during grazing, if shown, can indicate the preferred side.



# Abstracts

*Poster presentations*

## **Note**

Each abstract ends with a short message for lay persons (marked **LP**). The message is intended to briefly summarise the most important practical take-home message from the presented study.



## Effects of handling on fear reactions in young horses

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Assessments of fearfulness in horses are relevant to both horse welfare and human safety, and the inclusion of objective temperament tests at practical horse breeding evaluations is of increased interest. It has been debated whether such tests should involve human handling, since there may be considerable differences in horses' handling experience. The aim of the present study was to investigate the effect of a short-term standardised handling procedure on reactions of young horses in fear tests with and without human handling. This was investigated in a controlled experiment with 24 three-year-old Icelandic horses. Handled horses (n=12) were trained according to a standardised handling procedure whereas controls (n=12) remained untrained. Behavioural and heart rate responses in a novel object test (NOT) and two handling fear tests (HFT) were measured. The HFTs were conducted with both an unknown (HFT-unknown) and a known handler (HFT-known). There was no effect of the handling procedure on the horses' behavioural and heart rate responses in the NOT, nor in the HFT-unknown. In the HFT-known, however, handled horses showed a significantly shorter duration of reluctance behaviour compared to controls (Wilcoxon test: (s, median [25;75%-quartile]), Handled: 0 [0.0;0.0], Control: 0.75 [0;10],  $P=0.03$ ), whereas heart rates did not differ. Heart rates correlated significantly between tests (e.g. HR-max in NOT and HFT-known: Spearman's rank correlation:  $r_{23}=0.5$ ,  $P=0.02$ ) and appear less affected by previous handling. This study suggests that previous handling may affect the behavioural fear response of horses when handled by their usual handler, whereas this effect does not apply to unknown handlers. Hence, handling by the horses' usual handler should be avoided during testing if fear tests are included at practical breeding evaluations.

**LP:** Training horses in basic handling routines may decrease the behavioural response in a fear-eliciting situation when the horse is handled by its usual handler. The horse may still be frightened, but the reduction in behavioural fear response could be beneficial for human safety.

## **A method for measuring the daily rhythms of resting behaviour to enhance the welfare of athletic horses**

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Although animal welfare has become a growing concern among Japanese riders, there is no appropriate tool to assess the welfare of horses objectively. We hypothesized that the regular daily rhythms of resting behaviour is an indicator of good welfare in horses. The objective of this study was to develop a simple method of measuring the daily rhythms of resting behaviour in horses. Two clinically healthy Thoroughbreds and two Anglo-Arabs were used. Animals were housed in each box (3.5 x 3.5 m) with windows in a stable at Hiroshima University. Horses underwent fitness training 6 days/week with rest day on Mondays. The study was carried out for 2 months from October to November 2011. ActiCal (Mini Mitter) which is a small, omni-directional accelerometer that accurately measures human physical activity was placed on each horse's poll by means of a halter for 2 months. Activity was recorded with a sampling interval of one minute. We classified activity of 0 as resting behaviour based on videotaped recordings. The daily rhythms of resting behaviour for each horse were estimated using the first month data. The rhythmic pattern was compared among 4 horses using chi-square test. The duration of resting behaviour was compared between the horses using t-test. Around the middle of the second month, the horses were transported to participate in a 2-day competition. The changes in the rhythmic pattern and the duration of resting behaviour as a result of participation in the competition were determined using chi-square test and paired t-test, respectively. The rhythmic pattern of resting behaviour was not significantly different among the horses but the duration of the resting behaviour was significantly different among the horses ( $P < 0.01$ ). Participation in the competition changed the rhythmic pattern of resting behaviour significantly ( $P < 0.01$ ) and the duration of resting behaviour decreased significantly ( $P < 0.01$ ) by 14% on the evening when the horses came back to the stables. The results suggest that the accelerometer can easily measure the rhythmic pattern and the duration of resting behaviour in horses and can detect their changes brought about by participating in competitions or other off-farm activities. Future research should investigate to relate changes in the resting behaviour of horses with changes in physiological response (e.g. corticosteroid levels) to evaluate the welfare status of horses using the accelerometer.

**LP:** The purpose of this study was to develop a method of measuring the daily rhythms of resting behaviour in horses. It is possible that our method could assist with evaluating the welfare status of horses by detecting the changes of the rhythmic pattern and the duration of resting behaviour.



## **Does familiarity affect the heart rates of horses and their handlers during an in-hand task?**

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Physiological responses that occur in horses and humans during their interactions have been investigated in a number of studies with some intriguing results. Here we explore how the heart rates of horses and humans vary when working with a familiar or unfamiliar partner to complete a short obstacle course in-hand. Twenty-one horses were recruited to the study along with their familiar human handler. Each horse was led in-hand around a short course, which included weaving in and out of obstacles, halting, backing-up and a few strides of trot, by a familiar and unfamiliar handler in a pseudo-randomised order. Both horses and humans were fitted with Polar heart rate monitors. Complete sets of horse and human heart rate data for both familiar and unfamiliar pairings were available for seventeen horses. There was a significant order effect with higher horse heart rates seen the first time around the course regardless of who was leading (Wilcoxon test:  $Z=-2.67$ ,  $P<0.05$ ). However, despite this, the horses' heart rates were significantly higher with the unfamiliar handler than with the familiar handler (Wilcoxon test:  $Z=-4.46$ ,  $P<0.001$ ). In contrast, human heart rates were higher when paired with a familiar horse compared with an unfamiliar horse (Mann-Whitney U test:  $Z=-5.08$ ,  $P<0.001$ ). Significant correlations between horse and human heart rate were seen in three familiar pairings and two unfamiliar pairings. Our findings indicate that the relationship between horse and human heart rates during interactions is not straightforward and is likely to depend on a number of factors such as experience of the situation in question. Although the lower heart rates seen in horses being led by their familiar handler suggest that they are more relaxed with someone they know, this could not be said for the human partner, perhaps implying that humans are more anxious about 'getting it right' when working with their own horse in what could be perceived as a test situation. This hypothesis was supported by interviews of the handlers following course completion.

**LP:** Familiarity of horse-human pairings does appear to influence the heart rates of both parties during the completion of an in-hand course in an experimental situation.

## Physiological parameters of equine welfare in therapeutic riding horses

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Therapeutic riding (TR) horses come from diverse backgrounds, and behavioural issues in horses are not always immediately apparent. TR centres use different protocols to assess the suitability of horses for this type of work, with trial periods lasting from weeks to months. This study compares behavioural (video recording, ethogram) and physiological parameters (cortisol and heart rate variables, HR) of horses, and aims to contribute to the establishment of an effective protocol for the selection of horses for TR purposes. 12 horses (5-27 years old; Quarter Horses, 1 Thoroughbred, 2 Appaloosas; 4 mares, 8 geldings) from a local PATH premier-approved TR centre were subjected to three tests: Horses' reactions to an unfamiliar roundpen with low visibility to the exterior (AR, gregariousness, test period 5 min). Exposure to a 5-ft wide colourful umbrella suspended upside down in the centre of the round pen (NO, fearfulness, test period 5 min). Lastly, crossing and standing for a minimum of 3 seconds on a novel object (BR, wooden bridge wrapped in bubble wrap, short walking distance from the arena, with test duration  $\leq 2$  min). Salivary swabs were obtained directly before the first test (AR), and immediately after the test sequence (AR/NO/BR) was concluded, approximately 30 min later. Next, horses were assessed during a therapeutic riding lesson (RL). Salivary swabs were obtained directly before the mounted portion of the RL, and immediately after the riding instruction concluded, approximately 30 min later. Cortisol was determined with a salivary immunoassay kit (Salimetrics, Carlsbad, CA, USA). HR were recorded for all tests and RL with a Polar Equine RS800CX receiver and calculated with Polar ProTrainer5® Software. Results were extracted with a very low, medium and very high filter for error correction. No significant differences ( $P \geq 0.05$ ) were found between the filters. As expected, baseline mean HR ( $36.083 \pm 6.42$ ) was significantly (paired t-test,  $P \leq 0.05$ ) higher during the tests (AR  $63.25 \pm 19.71$ ,  $P = 0.001$ ; NO  $57 \pm 16.51$ ,  $P = 0.0012$ ; BR  $52.75 \pm 6.14$ ,  $P = 0.0003$ ), as well as the RL ( $65.5 \pm 26.08$ ,  $P = 0.0044$ ). No significant differences in mean HR were found between AR/NO/BR/RL ( $P \geq 0.05$ ). Cortisol levels did not increase significantly. Ethograms were recorded for time budgets and incidents separately. 22 different incidents and 10 different kinds of activity were observed in AR and NO, but only 6 different types of behaviour in RL. Graphs display a wide spectrum of individual horses' physiological and behavioural parameters. In conclusion, AR/NO/BR and HR are valid tools to evaluate horses' suitability for the TR environment.

**LP:** Behaviour tests and heart rate parameters can contribute to the objective evaluation of potential therapeutic riding horses.

## Comparing objective and subjective evaluations of equine stress levels in the therapeutic riding environment

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Equine-assisted therapies use horses over many months at a time for various kinds of therapy work. Those horses come from diverse backgrounds, many times as donations, and are assessed on few parameters, often by different people in the organization. Accreditation bodies like PATH Int'l offer minimal guidance in selecting animals that work well in this environment. This study compares physiological indicators of stress in therapy horses with the handler assessments of the horses' behaviour and temperament. 11 horses (age 5-27, 3 mares and 8 geldings) at a local PATH Int'l premier-accredited facility were examined. Regular handlers (instructors, assistants and exercise riders) were asked to complete questionnaires pertaining to the horses' behaviour, traits and predominant characteristics. Baseline (BL) heart rate (HR) values were recorded with an HR monitor (Polar RS800CX), and a salivary swab was collected. Thereafter, horses were exposed to a novel environment (AR, 5 min in a round pen with restricted view to the outside), a neophobia test (NO, 5 min in same round pen, colourful 150-cm umbrella hanging upside down in the centre), and a novel object/handling situation (BR, horse expected to step on and stand for 3 sec on a bridge wrapped with bubble wrap). HR and behaviour were recorded continuously for each test. After the tests, the second saliva sample was collected, immediately frozen, and later analysed for cortisol (ELISA, Salimetrics, USA). Ten handlers (all adult females) completed questionnaires. Paired t-tests between treatments show significant differences ( $P \leq 0.05$ ) in mean heart rate (HR) and heart rate variability between BL HR and AR ( $P = 0.003$ ), NO ( $P = 0.002$ ) and BR ( $P = 0.001$ ), but not between AR/NO/BR. HR varied widely between horses within each test. We evaluated handler responses using a Likert scale: Responses about behaviour, personality traits and predominant characteristics were categorized within three previously validated major temperament factors (anxiety, trainability and affability). The questionnaires revealed partly individual, but no overall evidence for interobserver reliability (Cronbach's  $\alpha = 0.42$ ,  $\alpha \geq 0.7$  suggests interobserver reliability) for character traits, and borderline values were found for behaviour assessment (Cronbach's  $\alpha = 0.702$ ). We conclude that personnel should be trained to follow an established testing routine, with detailed guidelines to objectively assess horses for suitability in a therapeutic riding environment.

**LP:** Horses for therapeutic riding programs should be evaluated by specifically trained staff for objective temperament assessment. Risk of accidents can be decreased by matching the horses correctly to this type of work.

## Facial expressions as a tool for pain recognition in horses

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Recognizing pain in horses is challenging but vital for reducing the occurrence of untreated pain. Pain measurement in horses lacks a gold standard which complicates the development of pain evaluation tools. Facial expressions have proven useful for pain recognition in other species and therefore we studied the facial expressions in horses with experimental pain. These comprise 'low' and/or 'asymmetrical' ears, an angled appearance of the eyes, a tense stare, medio-laterally dilated nostrils and tension of the lips, chin and mimetic muscles. The aim of the present pilot study was to apply the pain face to horses with clinical pain. Eighteen hospitalized horses with known clinical diagnoses were included. The horses were video recorded in their stall and their pain status was evaluated by the first author, using a composite measure pain scale. Based on this pain evaluation and the clinical diagnosis, the horses were grouped into "no pain" (n=6), "mild pain" (n=1), "mild-moderate" pain (n=2), "moderate pain" (n=3) and "severe pain" (n=6). Twenty-six persons (5 veterinarians, 18 veterinary students and 3 lay persons familiar with horses) participated in a 20 minutes training session on the features of the equine pain face. Subsequently, they were asked to state whether or not the eighteen horses showed a pain face in the video sequences (20-30 seconds). Proportions of correct ratings (i.e. according to the previously determined pain levels) were calculated individually for all participants. False positives and false negatives were calculated for all participants as a proportion of the scores for the pain group and the control group, respectively. The participants scored the horses correctly in 61%-94% (mean 82%) of the cases, whereof 69% of the participants rated more than 80% of the horses correctly. The overall proportion of false positives (15%) and false negatives (16%) was equal. Stress, nervousness or black fur coat (difficult to distinguish details) was present in all video clips of incorrectly categorized horses, demonstrating stress as a confounding factor in pain evaluation and emphasizing the importance of evaluating horses without disturbing them. The low number of horses did not support calculations of sensitivity and specificity. However, the results indicate that facial expressions of pain can be applied to horses with clinical pain and may therefore prove useful for future pain scales. Furthermore, learning to recognize facial expressions of pain is feasible.

**LP:** Facial expressions can be used for the evaluation of pain in horses. Recognizing facial expressions of pain is easy and it is useful for various levels of pain.

## **Preliminary study demonstrating decreased eye blink rates in horses in response to induced stressors**

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Horses demonstrate a variety of responses when introduced to stressful situations, e.g. ears pinned back, restless, head high. In other species such as humans or cattle, eye blink rate (EBR) is used as an indicator of stress. Increased EBR is associated with anxiety, lack of concentration and decreased performance in humans. Little research has been done on EBR in horses in response to stress, but it is hypothesized EBR in horses will differ when exposed to stressful situations. Six horses were randomly assigned to each of four treatments: 1) Control - horse in its normal paddock environment; 2) Separation – horse was removed from its paddock mates; 3) Feed restriction – feed was withheld for 5 min at regular feeding time; and 4) Fear test – an umbrella was suddenly opened and closed while horse was alone in the arena. Eye blink rates (blinks/min) were retrospectively determined by two independent observers from video recordings of each horse's right eye for a duration of 1 minute. A one-way ANOVA with repeated measures was used to determine the effect of treatment on EBR, and Tukey's Honest Significant Difference test was used to evaluate differences among treatments. Eye blink rates were highest in the Control treatment (38 blinks/min<sup>a</sup>), and decreased when varying stressors were introduced to the horses: 20 blinks/min<sup>b</sup> during separation; 18 blinks/min<sup>b</sup> during feed restriction; 10 blinks/min<sup>c</sup> during the fear test; a, b, c, differ  $P < 0.0001$ . As prey animals, when horses perceive danger, they will raise their head to scan their surroundings and prepare for flight if the situation warrants it. The reduction in EBR in response to stressors may be caused by an increase in concentration, as has also been documented with humans. Eye blink rates are also positively correlated with dopamine levels, and thus may hold promise for a non-invasive relative measure of this hormone. While this study is limited due to the low number of subjects and lack of physiological measures, it provides a basis for further research.

**LP:** Accurate assessment of behavioural responses as a communication tool between horses and humans is a constant challenge. If horses rely on their physical attributes to communicate, then humans can use physical indicators such as eye blink rate to detect changes in the emotional state of the horse. Eye blink rate as a measure of stress in horses has not been studied to date, but preliminary analysis indicates that eye blink rates appear to decrease when the horse is subjected to a stressful environment and this non-invasive measure may potentially be linked to circulating hormones.

## Effect of equine appeasing hormone on heart rate of horses loaded for road transport

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Road transportation is a stressful event, even for trained horses, and involves risks for injury in horses as well as handlers. Treatment with equine appeasing hormone (EAP) has been claimed to have a calming effect on horses in stressful situations. The aim of this study was to compare the heart rate of horses treated with EAP to the heart rate of horses treated with placebo, when subjected to a stressful situation. Twenty adult horses were subjected to a transport-like situation. The horses were led out of their boxes, loaded onto a trailer, left in the trailer for 10 minutes (car motor running, vehicle not moving) and thereafter returned to their boxes. Heart rate (HR) was measured in beats per minute (BPM) during the procedure and 20 minutes after the horses had returned to their boxes. All horses were subjected to the test twice, pre-treated with either equine appeasing hormone or a placebo, administered as a gel applied on the skin around the nostrils. The order of treatment/placebo was randomized. The average HR was lower (t-test  $t=1.83$ ,  $df=19$ ,  $P=0.04$ ) when the horses had been pre-treated with equine appeasing hormone ( $47.8 \pm 5.94$  BPM) compared to placebo ( $50.8 \pm 7.0$  BPM). The maximum HR did not differ significantly between treatments. When the measurement period was divided into exposure (loading, standing in trailer, off-loading) and post-stress phase (standing in stable), there was a significant difference between treatments in average HR in the post-stress phase ( $P=0.02$ ), not during exposure. It was concluded that pre-treatment with equine appeasing hormone had a stress reducing impact in the tested horses, as measured by HR after a transport-like situation. If this stress-reducing effect also reduces the risks involved in road transportation of horses cannot be concluded from this study.

**LP:** Heart rate can be used to measure stress in horses. In this study, the effect on the heart rate of a calming scent-hormone gel applied around the nostrils of adult horses in connection with a stressful situation, transport, was tested. It was concluded that the heart rate was slightly lower when the hormone was given, compared to placebo.

## Equine stakeholder interpretations of equine stress responses

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The equine stress response comprises a number of components including behavioural expressions. How stakeholders interpret and respond to these types of behaviour has implications for the welfare of horses. Thirty-one in-depth interviews and six focus groups were conducted with a broad cross-section of equine stakeholders to explore their perceptions of welfare. The resulting transcripts underwent thematic analysis. Here we present findings relating to the theme of perception and interpretation of equine stress behaviour. Stress as a component of welfare was not discussed by all participants. One of the most striking aspects was the language the stakeholders' used to describe potential behavioural indicators of stress. A minority appeared to recognise stress behaviour and provided examples, e.g. 'teeth start to grind, the tail starts to swish....the eyes are rolling and they are groaning and they are sweating'. Some stakeholders did not describe specific stress behaviour but implied they could recognise a stressed horse. For example one participant said 'that horse is obviously screaming at you that it is not happy... It will be showing stereotypic behaviour or it just looks stressed or its behaviour under saddle is stressed'. They used alternative terms which could be synonymous with stress including 'anxious', 'frightened', 'edgy', 'having a head fit' and 'nervous'. Participants also recognised situations where a horse may become stressed, e.g. 'they'd be extremely distressed if they lost visual contact [with other horses]'. Whether or not a behaviour was interpreted as stress sometimes depended on whether it was seen to be 'normal' for that individual: 'If you've got Bob the Cob that's got his eyes on stalks, he's covered in sweat and shaking in the stable you know there's a problem. Similarly if you go and see a thoroughbred that's racing fit and it's behaving like that in the stable, you might think that's more, perhaps, towards a thoroughbred tendency'. Finally, stakeholders appeared to offer alternative explanations for behaviour which may have been indicative of stress. Some of the descriptors given to horses which were potentially stressed included: 'a miserable git', 'just the way they are', 'naughty', 'a toad', 'rude' 'moody' 'cheeky little monkey' and 'psychopath'.

**LP:** Equine stakeholders feel able to recognise a stressed horse, even though they often cannot articulate the individual components of stress behaviour. Stress behaviour may be incorrectly labelled which may have implications for the welfare of these horses, for example, if punishment is used as a result of the behaviour.

## Effect of the Stableizer® on heart rate and behaviour in Thoroughbred horses

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The Stableizer® is a device designed to induce sedation through peri-auricular and upper gum pressure. It consists of a looped cord passing behind the ears and on the upper gum. Its effect on heart rate (HR) (BPM) and behaviour in 27 thoroughbreds (6 mares, 2 stallions, 19 geldings; mean age±SD: 4.5±1.53 years) was investigated. Responses to a sudden visual stimulus (10 s umbrella closing/opening) were also included. The horses were matched in pairs for age and gender, in order to have two similar groups. Successive conditions for group 1 were (10 min each): No Stableizer® basal (NS-B; registration of basal HR without Stableizer®, no stimulus given), Stableizer® loose-basal (SL-B; Stableizer® is loosely attached, no pressure), Stableizer® loose-stimulus (SL-S; Stableizer® is loose and the sudden stimulus is given during the first 10 seconds of the period), Stableizer® tightened-basal (ST-B; Stableizer® is tightened, pressure of 7 kg), Stableizer® tightened-stimulus (ST-S; Stableizer® is tightened and the sudden stimulus is given during the first 10 seconds of the period). For group 2, the order of conditions SL-B/SL-S and ST-B/ST-S was reversed. PROC MIXED (SAS v9.3) was used to analyse HR (max, min, average) and behaviour, for the first two minutes and for the entire duration of a condition. Average HR during the first two minutes was lower for ST-S vs. SL-S (lsmeans±SEM: 66.97±7.77 vs. 74.76±7.77 BPM; P=0.047). Maximal HR during 10 min was lower for ST-S vs. SL-S (124.85±12.00 vs. 143.16±12.00 BPM; P=0.010). Minimal HR was never affected. In SL-S condition (vs. ST-S), horses startled more frequently with displacement of body (0.67±0.18 vs. 0.30±0.12; P=0.035) and tended to startle more in general (8.04±0.53 vs. 7.17±0.50; P=0.083). There appeared to be an effect of the order in which the SL and ST conditions were applied, as the maximal HR was higher in the SL conditions when they occurred before the ST (74.39±4.33 vs. 55.57±4.02 BPM; P=0.047). Also, more behaviour indicative of excitation occurred following the visual stimulus in an SL period when this preceded an ST period. Conversely, more passive behaviour was seen in an SL period when this was preceded by an ST period. This suggests an effect after loosening. Future research should include measurements of hormones and neurotransmitters to elucidate the potential sedating effects.

**LP:** The Stableizer® is designed to calm horses by pressure exerted by a looped cord behind the ears and on the upper gum. It did not decrease peak heart rate but shortened its duration. Horses wearing the Stableizer® seem to calm down quicker. Its effect could continue a while after cessation of pressure.



## **A pilot study into the stress levels of horses kept in a college riding school environment**

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Domestication has led to many horses being kept in unnatural environments. It is important to understand how horses react to various stressors, such as prolonged stabling, for health and welfare reasons. This study aimed to identify the stress levels of a random selection of college riding school kept horses using salivary cortisol and heart rate responses as the indicators. Six horses of mixed age (14.8 y.o.±7.8) that had not previously been housed at the college riding school were selected at the start of an educational term (Sept) and heart rate (HR) and salivary cortisol levels recorded as a base line within one week of their arrival. HR was recorded via a Polar Heart Rate monitor and saliva samples were taken at the same time. This was carried out during the lunch period on the yard when it was closed and so quieter than at other times of the day. This was repeated at the end of the educational term in December and a t-test of paired sample of means conducted to analyse the data. The results suggested that there was no significant difference in heart rate (bpm, mean±se, Sept: 32.17±4.07 and Dec: 33.17±2.32,  $P>0.05$ ) or in salivary cortisol (ug/dL, mean±se, Sept: 0.115±0.04 and Dec: 0.130±0.02,  $P>0.05$ ), but there were individual variations between horses. Based on these results and the low number of horses, conclusions on the horses' status of habituation to the riding school environment cannot be drawn. Further research is needed into the topic and this study could form the pilot for a larger sample population study and data could be then collected at varying time periods throughout the educational term to determine the point of habituation which in itself could be valuable information for the Yard Manager and staff.

**LP:** Understanding how horses react to new environments should be of interest to all horse owners whether their horses are stable or field kept. The owner should be aware of the individual nature of this aspect of health and welfare for each horse and act accordingly to prevent the onset of stress related conditions that may otherwise be avoided.

## Can faecal cortisol metabolites be used to measure weaning stress in foals?

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The hypothalamic-pituitary-adrenocortical (HPA) axis is activated and cortisol secreted into circulation when horses anticipate or face stressors. Increased concentrations of faecal cortisol metabolites (FCM) have been used as stress indicator in adult horses and it has been shown that FCM concentrations peak approx. 24 h after the stressor. FCM have not yet been validated for use in foals, and the aim of the present experiment was therefore to investigate whether weaning stress leads to an increase in FCM concentrations in foals. The abrupt separation of the foal from the mother is a stressful experience, including e.g. novelty, breaking of social bonds and change in nutrition. Before weaning, the foals (n=38; 24 males, 14 females) were kept in a group housing system (100 horses in total) and additionally fed roughage (maize silage, hay and straw) and barley. The foals were weaned abruptly at 6-8 months of age by loading 5-6 foals at the time into a transporter and driving 1 km to a new stable where they were housed in group boxes. Feed remained the same and the foals were familiar to each other; thus the stressor consisted of a combination of breaking of the social bond to the mare, change in nutrition (no milk), transport and housing in a new environment. Fresh faeces was collected from individual foals immediately after defecation on the day before weaning (Day 0), and on Days 1, 2, 3 and 10 after weaning. For each foal, the time of weaning (i.e. when the foal was taken out of the mare group) was registered and faeces collection was conducted within two-hour intervals at 23-25 h (Day 1: n=35), 47-49 h (Day 2: n=37), 71-73 h (Day 3: n=36), and 239-241 h (Day 10: n=38) after weaning. Weaning resulted in a significant and marked (approx. 47%) increase in FCM on Days 1-3 after weaning (RM ANOVA; ng/g (mean±se): Day 0: 19.5±1.8, Day 1: 30.9±1.9, Day 2: 27.6±1.2, Day 3: 27.3±1.3, Day 10: 19.5±0.9, F=15.4, P<0.001). On day 10 after weaning, the FCM returned to the concentration before weaning (P=0.68). The FCM concentrations were not influenced by foal's sex (P=0.72). Weaning transiently increased cortisol metabolites, demonstrating for the first time that FCM can be used for non-invasive evaluation of stress also in foals.

**LP:** Non-invasive methods for estimating stress responses are valuable and can typically together with behavioural reactions be used for comparing the effects of several types of e.g. management and training practices in horses. The current study demonstrates that measurement of hormone metabolites in faeces can also be used to estimate stress in 6-8 months old foals.

## **Influence of reinforcement technique and husbandry-related factors on horses' reactions to training of a frightening task**

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In practice, success of positive reinforcement often seems to be limited, at least in the short term, when used with frightening tasks. Therefore, the aim of the present study was to compare a positive and a negative reinforcement regimen when training horses to cross a novel, potentially frightening object, i.e. a grid with an inbuilt, automatic brush designed for cleaning horses' hoofs. Twenty-four horses were trained by two different trainers either to step forward in response to tapping with the whip at the shoulder (NR; n=12) or to touch a target (a plastic bottle) which was rewarded by a handful of oats (PR; n=12). Subsequently, horses were asked to approach and cross the brush using the respective, previously trained method, using halter pressure via lead rope only to restrict the horse from moving away from the brush. Within the maximum allotted time of 3 training sessions of 30 min each, 21 horses learned to cross the deactivated brush. Three horses did not learn to cross the brush within that time. Only eleven horses learned to cross the brush when the engine moving the brushes was switched on. Based on generalized linear mixed model analysis for binary data, neither the reinforcement regimen, nor factors such as age, gender, breed-type (pony vs. warm-blood), sport discipline (dressage vs. jumping/eventing), the trainer (person A or B), type of shoeing (barefoot, 2 or 4 shoes) or husbandry conditions such as housing (indoor vs. outdoor) or access to pasture (yes vs. no) influenced the likelihood to crossing or the intensity of horses' reactions (mild or strong reactions; all  $P > 0.1$ ). Also, based on survival analysis, there was no difference in time to touching or time to crossing the brush between NR and PR (both  $P > 0.1$ ). However, the heart rate of mares trained with NR (least square means from mixed model analysis:  $86.2 \pm 5.2$  bpm) was significantly higher ( $P < 0.05$ ) during training compared to geldings trained with either NR ( $64.8 \pm 4.1$ ) or PR ( $63.2 \pm 4.4$ ) or to mares trained with PR ( $64.9 \pm 5.9$ ). Furthermore, ponies ( $82.6 \pm 5.3$ ) had considerably higher heart rates than warm-bloods ( $56.9 \pm 2.5$ ), and horses that did not cross the brush tended to have ( $P = 0.077$ ) lower heart rates ( $51.4 \pm 10.2$ ) than those that later crossed the brush ( $69.6 \pm 3.6$ ). Interestingly, horses with access to pasture ( $62.8 \pm 3.2$ ) had lower heart rates than horses housed without access to pasture ( $76.7 \pm 4.5$ ;  $P < 0.05$ ).

**LP:** If learning theory is applied correctly, there seems to be no clear advantage for either PR or NR training techniques when training horses to a frightening task. Factors, such as gender or housing, influence heart rate but not behaviour during training.

## **Should I stay or should I go? Horses can be trained more easily on a Go/No-go paradigm than on an Active Choice paradigm**

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Welfare includes both physical health and emotional well-being, and cognitive biases have recently been proposed to reflect animals' underlying mood state. Several test paradigms to assess judgement biases have been developed for various species. In horses, spatial judgement bias tests have been used but it is unclear whether the latency measurements provide valid measures of emotional valence. The aim of this study was to compare two test paradigms based on choices, a Go/No-go paradigm (GNgP) and an Active Choice paradigm (ACP), in terms of time needed for training and variation in test outcomes. Five stallions and five mares were randomly assigned to the two paradigms and trained for 10 trials per day to discriminate between a low and a high tone. In the GNgP, horses learned to approach a bucket for a food reward when presented with one tone, and to stay in the start box when presented with the other. In the ACP, two buckets were presented and the horses were trained to approach the bucket on one side in response to one tone to obtain a big reward and to approach the bucket on the other side in response to the other tone to obtain a small reward. After reaching a predetermined learning criterion, horses were tested for four days with three intermediate tone-trials interspersed between 10 high and low tone-trials. All five GNgP horses but only one ACP horse reached criterion in an average of 38 training sessions (ranging from 25 to 52 sessions). Training was stopped after 40 sessions in the remaining ACP horses whose performance did not improve. During testing, the GNgP horses showed an intermediate response with a slightly positive bias (63%) to the three intermediate tones without discriminating between them. Moreover, individual horses responded differently to the intermediate tones. Thus, horses can be successfully trained on a GNgP based on auditory cues, while a comparable ACP may be too difficult for them to learn. However, further refinements will be needed to render this GNgP a valuable tool for assessing emotional valence in horses.

**LP:** Cognitive bias tests provide a useful tool for the assessment of horses' emotional states and therefore horse welfare. The test is based on the assumption that emotions influence judgement and that we can in turn draw conclusions from these judgements about a horse's underlying emotional state.

## Correlation in learning performance between mares and their foals

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Learning performance is shaped by a combination of genetic and environmental factors. In this study we aimed to investigate correlations in learning performance in three learning tests between mares and their foals, hypothesising that mares and offspring would rank similarly within the different tasks tested. Learning performance will be evaluated on 60 mare-foal pairs using three different tasks, a visual discrimination task (VD), a clicker task (CT) and a spatial reversal task (SR). The VD test requires the horses to learn within 10 trials that only one of two buckets, different in colour, shape and size, contains an attractive food reward. The CT test requires the horses to touch a target (green, square plastic lid) placed in four predetermined positions with their muzzle. A correct touch will be rewarded with a click, immediately followed by a food reward. The SR test requires the horses to select the opposite bucket from that which have initially been trained. The horses will be tested in all three tests on two consecutive days post-weaning (Day 1: VD test, Day 2: CT and SR). In 2013, 18 mare-foal pairs were tested (foal age: 30-50 weeks) in the VD and CT tests (SR will only be used in 2014). Data from these pairs were screened to assess whether the tasks used were feasible for the horses. Fifteen mares and 8 foals completed the VD test whereas the remaining mares and foals stopped responding before completing the 10 trials. Of the completing horses, the mares made between 6 and 19 mistakes (mean±s.e.: 11.6±1.1) and the foals made between 3 and 10 (mean±s.e.: 6.9±0.8). In the CT test, three foals and 2 mares did not pass the initial shaping procedure within the 10 min test time. The remaining 15 foals and 16 mares achieved between 7 and 63 (mean±s.e.: 29.4±4.2) clicks and 1 and 93 (mean±s.e.: 39.6±7.7) clicks, respectively, in the post-shaping procedure. In 2014, we have accommodated the problems with unresponsiveness in the VD test, which we suggest was caused by lack of food motivation. Data from 2014 is currently being collected on additionally 42 pairs; collection will finish May 2014.

**LP:** This study aims to investigate connection in learning ability between mares and their foals in three learning tests. The data collected 2013 in the visual discrimination and clicker tests showed individual differences in learning performance for both mares and foals, but also a large proportion of the foals stopped responding in the visual discrimination test. Modifications of the tests for experiments performed in 2014 have been performed to enhance the assessment of learning performance between mares and foals. Analysis on data from both 2013 and 2014 will reveal if a correlation between mares and their foals exists.

## Social Learning in Young Icelandic Horses

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Social animals should have plenty of opportunities to learn from conspecifics, but most studies have failed to document social learning in horses. This study investigated the ability of young Icelandic horses (n=46, 2-3 years old) to learn a spatial detour task by observing a trained, familiar and dominant demonstrator of either the same age (Experiment 1 and 2, n=22) or older (Experiment 3, n=24) performing the task. In Experiment 1, the task consisted of a fenced square (8 x 8 m) with a 2.5 m opening in the left side, giving access to feed containers placed in the middle of the square. Observer horses (n=11) were allowed to observe a demonstrator horse being led 3 times through the detour route immediately before being given the opportunity to solve the task. Controls (n=11) were allowed to observe the demonstrator horse eating in the middle of the square but without demonstrations of the detour route. Four observers and 7 controls solved the task in their first trial (Fisher's Exact test:  $P=0.15$ ). In Experiment 2, the test arena (18 x 20 m) was divided by a fence and feed containers were placed on the opposite side of the fence from the starting point. All horses were first trained to go through an opening to the right to get to the feed containers. Subsequently, this opening was closed and the horses were allowed to explore the arena without being able to access the food. Observer horses were then allowed to observe 3 demonstrations by the demonstrator walking through a new opening in the left side of the fence. Seven observers and 3 controls solved the task in their first trial (Fisher's Exact test:  $P=0.07$ ). In Experiment 3, we had the opportunity to repeat the second experiment with a new group of horses (n=24) and older demonstrators (n=8), because it has been suggested that older horses may serve as better demonstrators (Krueger et al., 2014, Anim. Cogn.). Five observers and 8 controls solved the task (Fisher's Exact test:  $P=0.28$ ), suggesting that observer horses also did not benefit from having the task demonstrated by an older horse. In conclusion, horses exposed to prior demonstration did not perform better than control horses in solving a spatial detour task.

**LP:** Although it is a common belief that horses are able to learn new types of behaviour from each other, most studies - including the present study - have failed to demonstrate that horses possess the ability to learn from observation of conspecifics.

## **Do habituated demonstrators affect the likelihood of horses crossing a novel surface?**

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Habituated horses have been found to have a calming effect on conspecifics, and this study investigated whether a habituated demonstrator influenced the willingness of young Icelandic horses (2-3 years old) to cross a novel surface. All horses were initially trained to go through a 4-m opening in a fence to obtain food. In Experiment 1 (n=22), a white linen (1.5 x 4 m) was placed in the opening and observer horses (n=11) were allowed to observe a similarly aged, habituated demonstrator horse being led 3 times across the linen, immediately before being given the opportunity to solve the task. Controls (n=11) were allowed to observe the demonstrator eating on the opposite side of the linen but without demonstration of crossing the linen. All observers and controls succeeded the task, but observers had significantly lower heart rates, compared to controls (e.g. average HR: ANOVA, mean±se (bpm), Observer: 66±1.5 vs. Control: 73±1.6, P=0.007). In Experiment 2 (n=23), we repeated the study on a new group of horses, using a potentially more fear-eliciting task and older demonstrators. The opening in the fence was covered by white, shiny plastic (1.2 x 4 m) and tripods (1.2 m high) covered by coloured blankets were placed on each side of the plastic. Ten of 12 observers and 10 of 11 controls succeeded the task and the groups did not differ in their latency to succeed (Kaplan-Meier survival analysis: Log-rank, P=0.69). Furthermore, the groups did not differ in HR (max HR: ANOVA, mean±se (bpm), Observer: 70±4.9 vs. Control: 70±4.8, P=0.96). The high number of controls that solved the tasks without prior demonstration suggests that the intensity of the tasks were too low in both experiments. This is interesting since we have previously used a similar set-up for warm-blood horses which showed intense fear reactions towards these stimuli. Although the first experiment suggested a calming effect of a demonstrator, we were unable to repeat this result in a similar set-up with a new group of horses.

**LP:** It has previously been shown that company of a habituated horse has a calming effect on conspecifics. In this study, we investigated whether prior observation of a trained demonstrator crossing a novel surface affected the behaviour and heart rate of young horses performing the same task, and we found contradictory results as to whether the demonstrator had a calming effect.

## **A pilot study investigating the prevalence of loading problems at an equine referral hospital**

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Behaviour problems such as loading in horseboxes or trailers can result in time delays, frustration and potential injury to horse or handler. Consequences of poor loading responses may include being unable to get the horse to a hospital for treatment, or delaying it. At discharge, poor loading may be detrimental to their existing condition, especially orthopaedic injuries if a prolonged time is spent moving around or hyper-reactive behaviour exhibited. To assess whether loading is a significant behaviour problem, data was collected over a 6 month period at an equine referral hospital. Clients were included in the study if the horse spent more than approximately 1 minute standing at the bottom of the ramp when loading was attempted, or after 2 or more failed attempts at walking up the ramp into the trailer. The age, type, use and reason for hospital visit were recorded. Length of time to load, method(s) used to facilitate loading and whether hospital staff assistance was required was also recorded for analysis. This study may indicate if horses that have undergone veterinary treatment/surgery are more reluctant to load, perhaps as a consequence of injury/illness and an unfamiliar environment. The data collection for this study will finish on 30<sup>th</sup> June 2014. As of 15<sup>th</sup> May 2014, 8.8% of 385 hospital appointments had problems loading when discharged, of which 76% required staff assistance. Time delays of over 30 minutes were recorded (26%); however, the majority (56%) were loaded within 15 minutes. Methods included using food, lunge equipment, IV sedation and stronger head restraint. The most popular successful method was using negative reinforcement through whip taps on the ribcage to make the horse walk forwards. This method was used the majority of times when staff assisted. Time is very precious in busy equine hospitals and involvement of staff in loading difficult horses prevents them from completing their normal work. The current study may encourage horse owners to practice loading with their horses, both increasing their own and their horse's confidence that they will load if they need to transport their horse to a veterinary hospital.

**LP:** Many horses are not completely confident when loading to travel, resulting in them refusing to load, causing time delays and stress for both horse and owner. This study at an equine referral hospital showed that around 9% of horses were not good loaders. This could delay veterinary treatment or make existing injuries worse. Owners should practise loading their horse at home to increase confidence when loading in everyday and emergency situations.



## **The effect of audio-visual training on novice rider performance of an equestrian dressage test**

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The use of sport-specific visual training to enhance performance of novice riders in the equestrian sport of dressage was assessed. Novice riders (n=15) each rode a series of dressage movements on two separate occasions. They were filmed for subsequent scoring by a registered dressage judge. An experienced dressage rider rode the same test and using the scene camera from a mobile eye tracker (ASL Mobile Eye) video footage was collected from the 'rider's eye' with simultaneous guiding narrative from the rider. The resultant audio-visual footage was used as a training aid. The riders were grouped as either T (n=7) or NT (n=8) with Group T receiving audio visual training prior to riding the same dressage test for a second time. Group NT received no interim audio-visual training. The first and second dressage tests ridden by all riders were presented randomly for scoring by the dressage judge. There was no difference between the scores of Group T and Group NT in the first dressage test (independent samples t-test). A significant improvement in the scores allocated for the second test was only found in Group T riders (mixed between-within subjects ANOVA:  $P < 0.01$ ). Audio-visual training resulted in improved performance in novice dressage riders. This form of training should be used to improve performance in dressage and has the potential to improve both performance and safety in other equestrian disciplines.

**LP:** Accurate use of visual cues is important when riding a dressage test and we found that the dressage scores of novice riders who had received visual training off the horse improved significantly whereas those who had not received the training did not. Visual training should be used as a means of improving both performance and safety in equestrian sport.

## **A Preliminary Study to Investigate the Number of Elite Dressage Riders Competing in Pain in the United Kingdom**

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Equestrianism is more dangerous than many sports including motorcycle riding, skiing, football and rugby with one in five equestrians seriously injured during their riding career. In addition to the high injury incident rate which could cause the rider to experience acute pain, saddle design and the lifestyle of elite riders could further aggravate the symptoms of chronic pain. An elite rider suffering from pain may still choose to compete with pain due to the pressures from sponsors and owners and the need for competition success to promote the rider and support the rider financially. The welfare of the rider needs to be considered and continuing to ride with pain is an issue which British Dressage needs to address. Therefore, this study is a preliminary study which aims to identify the number of elite dressage riders competing with pain in the United Kingdom which should provide British Dressage with an incentive to develop sports medicine, education for coaches, rehabilitation techniques for the rider and improve ergonomic technology, all of which would increase performance. In order to meet the aim of this study, a quantitative approach was used due to the experimental nature of the study. Questionnaires were distributed to 50 elite dressage riders at the Festival of Dressage located at Hartpury College to establish the prevalence of competing with pain. In order to achieve the most reliable results, professional elite dressage riders were used as the lifestyle and workload of these riders is more likely to be standardised in comparison to amateur riders. 74% of elite dressage riders compete while experiencing pain. Pearson's Chi<sup>2</sup> Test was used to identify any associations and statistical significance was set at  $P < 0.05$ . There was a highly significant relationship between competing with pain and pain affecting negatively on performance ( $X^2=16.216^a$ ,  $df=1$ ,  $P=0.000$ ) and the rider experiencing pain and the treatment of pain ( $X^2=50.000^a$ ,  $df=4$ ,  $P=0.000$ ). Further research is needed to determine why riders continue to compete with pain; the impact competing with pain has on rider performance; the design of dressage ergonomics and to identify a method of treatment of pain which riders can use to comply with the World Anti-Doping Agency's mission of clean sport.

**LP:** In equestrianism, there is a high injury incidence rate which could cause acute pain to the rider. Furthermore, the lifestyles which professional riders endure could also cause chronic pain to the rider. As a result, a study was conducted to establish the number of elite dressage riders competing with pain in the United Kingdom. 74% of elite dressage riders used in the study competed while experiencing pain. This information can provide British Dressage with an incentive to improve sports medicine, dressage ergonomics and rehabilitation techniques for the rider.

## **Do elite event riders use scientific training principles to prepare their horse for competition?**

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Empirical sports research suggests most athletes utilize a training programme incorporating scientific sports theories such as the principles of training and periodization to enhance and organize the training undertaken to prepare for competition. However, the training programmes used by elite event riders for their horses have not been researched although there is lay evidence that they are incorporated. The aim of this study was to fill the gap in the research and to investigate whether scientific sports principles are used by elite event riders to prepare their horses for competition. The objectives were to compare and contrast the training programmes used by 5 elite event riders utilizing qualitative research methods to identify how scientific training principles have been used to devise training. The participants consisted of 5 elite event riders who have completed CCI\*\*\*\* level events. Semi-structured interviews were the selected study method for data collection to solicit the experiences and opinions of the participants in regard to elite event horse training programmes. The interviews were analysed using content analysis and the results were presented using a thematic structure form. Thematic analysis of the data revealed there were 663 meaningful units represented as first order themes. The three main categories the themes fell into were 'Meet physiological demands of eventing' 'Training Programme Design' and 'Periodization'. The study's findings revealed that elite event riders undertake training incorporating scientific training principles such as the principles of training to enhance the horse's performance, reduce the risk of injury and to meet the physiological demands of eventing. However, each rider's training programme was different suggesting there is not a strict, set programme for elite event riders to use. The highest recurring themes revealed by the data and the primary deciding factors for training allocation was specificity to the individual horse and ensuring that training was specific to the demands of eventing therefore ensuring maximum preparation for competition. Training was also highly influenced by the facilities available to the rider as both gradient and a variety of surfaces were used to mimic what is found at competitions and to increase training efficiency. Periodization of an elite event horse's training programme is utilized to add structure and organisation of the phases of the year. The data suggests a two peak periodization model is often used by elite event riders to accommodate there being two major competitions in the season for an elite event horse.

**LP:** In sport, athletes utilize tailored and structured training programmes to prepare themselves for the demands of competition. This study suggests that elite event riders use scientific training principles to prepare their horses for competition. Therefore, knowledge and understanding of scientific training principles is needed to successfully structure a training programme for eventing.

## **Riding Instructors' Pedagogical Practice – An activity theoretical study**

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The aim is to describe and understand instructors' pedagogical practice in riding lessons with groups of pupils. Lessons of ten riding instructors were observed and the instructors were interviewed before and after the lesson. Observations and interviews were based on the concepts 'communication', 'feeling' and 'communication of feeling'. An analytical model of a so called activity system with six nodes, called "knots", formed the theoretical base for the empirical study (Engeström *Learning by expanding*, 1987). A knot can be e.g., an actor or a tool for action or the object on which the system operates. By studying tensions, or contradictions, between the knots we can arrive at an understanding of the structure of an activity system, here the riding lesson. Contradictions were seen at four different levels, e.g.: (1) The instructors wanting to communicate about the feeling of riding, but lacking words for it; (2) Pupils having difficulties concentrating on both the horse's actions and the instructor's instructions; (3) The instructor wishing to improve her teaching but traditions inhibiting this; (4) Within the general school system modern teaching methods have developed, expecting pupils to assume certain responsibility for their own learning and leaving room for this. This stands contradictory to the controlled riding lesson. Instructors' statements and actions reflect that the wellbeing of the horse is most important to them – this is an activity system with *horse* focus. Other instructors show an orientation towards the pupils and their learning – an activity system with *pupil* focus. Finally, there are some statements and actions that reveal e.g. ignorance or incompetence – an activity system with *routine* focus. Among the ten instructors the horse focus prevails in five cases and the pupil focus in four cases. The routine focus dominates with only one instructor. However, all ten instructors oscillate continuously between the three focuses, dependent upon the other knots. Horses are quite influential on instructors' thinking about instruction. From an educational perspective, however, it is desirable for instructors to place the pupils and their learning in the centre. There is a need for more pedagogic education for riding instructors. A challenge is to develop riding lessons with emphasis on the optimization of the conditions for pupils' learning while still caring actively for the wellbeing of the horse.

**LP:** The situation for instructors during riding lessons is complex and dynamic with both the horses and the riders to care for. Instructors tend to alternate focus between horses and pupils. The challenge is to optimize pupil's development in riding with continued care for the horse's wellbeing.

## **Survey of Canadian Certified Coaches' Understanding and Application of Learning Theory in Horse Training**

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The use of learning theory (LT) in the training of horses has received much attention recently. Its incorrect application has been shown to increase equine behavioural problems resulting in an increased risk of injury to horse and rider and a decrease in equine welfare. This study was a constructive replication of Warren-Smith and McGreevy's 2008 Australian (A) study and used a questionnaire to determine Canadian (C) coaches' understanding and application of LT. The demographic section was adapted to reflect differences in the Canadian coaching system. Using closed questions, coaches were asked to rate the usefulness of positive reinforcement (PR), negative reinforcement (NR) as well as punishment (P). Open-ended questions allowed the coaches to explain their use of each and their answers were marked according to Skinner's 1953 definitions. Further closed questions were added to explore the frequency at which coaches' horses experienced behaviour problems and to allow the rating of the effectiveness of 6 different rewards. Comparisons were made between the C and A coaches' responses. With a sample size of 1879, the response rate of 20.8% showed a good representation of C coaches. Significantly fewer C (12.2%) than A (19.3%) coaches rated NR as very useful ( $P < 0.001$ ). The majority of C and A coaches explained NR as P, which may explain the positive relationship between the increase in the frequency of behaviour problems and the usefulness of NR ( $W = 51993.0$ ,  $P < 0.005$ ). The majority of A (79.5%) and C (81.2%) coaches rated PR as very helpful although 72.9% of C coaches explained it either incorrectly or as NR or NR and PR. Significantly more A (5.2%) than C (2.6%) coaches deemed P very useful ( $P < 0.05$ ) and explained it correctly (46.3% and 33.9%, respectively;  $P < 0.001$ ). Of the C coaches experiencing behaviour problems 5-10 times/week, 43.3% rated punishment as useful. As in the A study, the majority of coaches (82.3%) considered releasing the aid the most effective reward. In essence this is NR. Despite C coaches rating PR more useful than NR, they are primarily using NR. This study confirmed the findings of the A study. Canadian certified coaches do not seem to have a sound understanding of the use, application and terminology of LT.

**LP:** As LT governs the way animals learn, coaches, whose supposed expertise is in the realm of training horses, should thoroughly understand and apply its principles effectively. Confusion as to its use and application exists in Canada, as in Australia. The comprehensive inclusion of LT in coaching manuals would improve equine welfare, and reduce the injuries to horse and rider often attributed to equine behaviour problems.

## **Riders' perception of their communication with the horse**

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This study is part of a project with the overall aim to improve riding education through a better understanding of the interplay between rider, riding instructor and horse. The rider influences the horse through a combination of weight, leg and rein aids together with the voice. The horse responds to these, and the rider receives and interprets these responses. The current study aimed to describe and analyse the riders' perceptions and views on this communication. Fifteen experienced riders (all female) of intermediate level in dressage were recruited to participate in the study, most of them riding their own horses. The riders received private training from five experienced riding instructors/trainers. One training of each rider was video and audio recorded. Directly after the training, the riders watched 10 minutes from the video recording (stimulated recall) followed by a semi-structured in-depth interview. The riders were asked to give a general description of how they communicated with their horses. They were also asked to describe how they interpreted the horse's responses to the rider's signals and how they acted when the horse responded/or did not respond to their signals. The results showed that all riders were well aware of the importance of giving clear and precise signals to the horse and to remove a given signal (aid) as soon as the horse responds. Most riders (12 of 15) agreed that it is essential to check that the horse responds to the rider's basic signals in the beginning of each training session. The riders also pointed out that it is important to adjust the aids to the character of the horse and to the current physical and mental status of their horse. When the horses responded correctly on the rider's aids, the riders praised the horse either by using their voice or by petting the horse. When the horse did not respond as the rider wished, the riders generally repeated or strengthened their signals until they received a desired response. Interestingly, a major part of the riders (13 of 15) blamed themselves when the communication with the horse failed. In conclusion, the riders seemed to be aware of the practical application of the basic principles of learning theory, even if they were not familiar with the terminology. However, the riders also reported that in practice they perceived difficulties to control their own bodies and to adequately give and release their signals.

**LP:** The present study is the first part of a larger project in which we want to better understand the complex didactic process between rider, riding instructor and horse. We believe this will lead to improved performance and well-being for horses and riders. In this first step, we gained better knowledge about how riders perceive the communication with their horses.

## Unintended reactions: The public's response to equine welfare

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At times equine scholars can become removed from the layman, or general public, and overlook the perspective and potential unawareness of the public. This divergence can evoke unintended reactions and the development of negative perceptions from the public that may be harmful to a study and yet provide scholars with unexpected discoveries and enlightenment. This case study reviews show horse exhibitors' reaction to a survey on the welfare of stock type show horses, as well as a glimpse of findings from the survey revealing participants' perspective on the word choice of *welfare*, *well-being*, and *care and treatment*. The survey was distributed through social media (primarily Facebook within the United States) following a modification of Dillman's approach, a survey design and administration method. Understanding the uncontrollable nature of social media, it was anticipated people would share unrestrained opinions and feedback about the survey. With an interest in the public's uninhibited thoughts, researchers prowled social media searching for posted comments related to the survey. When reviewing comment posts found, in addition to in-survey comments, the public's impression of a survey on equine welfare was brought to light. Qualitative content analysis revealed a defensive nature of the comments, associating use of the word *welfare* with activist and animal rights groups. This perspective of word use was also reflected in the survey with 69% (n=967) of respondents indicating that they prefer word use of *Standards of Care and Treatment for the Horse* over *Standards of Well-Being for the Horse* (19%) and *Standards of Welfare for the Horse* (12%). Explanations for their preference against the word use of welfare included such reasons as it is prone to misconceptions and misinterpretation, too opinionated, antagonistic, emotional and not science-based, anthropomorphic, and associated with activists/animal rights groups. Findings from this case study and survey emphasize the need for scholars to be mindful of word use when sharing information with the public as there may be unintended, negative reactions that could prevent a target audience from utilizing the information and counteract the intended good. However, as with this study, these unplanned findings and revelations pertaining to the perception of the word *welfare* are invaluable and should be considered when disseminating equine welfare studies to the public and developing equine welfare curriculum. Considerations should be made regarding if and how to reframe the US equine industry's perception of the word *welfare*.

**LP:** This case study reviews how the US public reacted to the word use of *welfare*. There was a strong opposition to the word as people associated it with activist/animal rights groups, making people feel judged and the need to be defensive.

## **Assessing the Impact and Viewpoints of Attendees of the 2013 International Society for Equitation Science Conference**

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An outcome assessment was performed at the 9th International Society for Equitation Science (ISES) Conference (Delaware, USA) aimed at identifying strategies to broaden the reach of ISES, and to foster further collaboration among conference participants, academia and equine industry representatives. A descriptive study was conducted to: 1) collect attendee demographics, 2) determine viewpoints regarding current industry issues and 3) discover plans for dissemination of conference information. Pre and post surveys were developed using a mixed method approach. Data were analysed with IBM/SPSS Statistics 21, and frequencies are reported. Country of origin items were collapsed into North American (NA) and European/Australian (EA). Comparison data were analysed using Mann-Whitney U, and relationships between items were tested with Spearman's correlation. Qualitative data was collected by asking open ended questions; comments were examined and themes identified. Forty-two respondents indicated they were from NA, with 20 from EA. Forty-two per cent of respondents identified their primary role in the industry as Academic, followed by University/College student (13%). The most popular horse disciplines were Dressage (71%) and Eventing (50%). Participants from EA agreed more strongly than NA with the statement regarding horses being defined as pets/companion animals versus livestock ( $P < 0.009$ ), and in response to the statement "I support the concept of animal rights" ( $P < 0.001$ ). "Unwanted horses and what to do with them" was identified as the primary issue facing the equine industry. Participation in ISES positively impacted knowledge and understanding of attendees in various aspects of equitation science. Attendees were very happy with the program speakers. Most attendees planned to share the information they had learned through personal interactions. Direct contact with clients was the most common means through which participants planned to share conference information. Few participants (4) indicated intent to disseminate information to the general public through websites, blogs, etc. It was suggested that ISES look at a more concerted effort to broaden the scope of research and conference topics to include more disciplines and develop a deliberate outreach plan to share the work that is done by the membership.

**LP:** The 2013 ISES planning committee conducted a survey to determine attendee viewpoints on various equine industry topics and to identify how people shared information gained from the ISES conference. The results obtained will help inform future conference planning, research needs, and outreach efforts.



## The impact of a calming supplement on performance in the equine athlete

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The difference between winning and losing in sport can sometimes be attributed to the psychological status of athletes. In equestrianism, a horse's temperament is often cited by riders as key to successful performance and horses that have trouble relaxing can be problematic. Magnesium and calcium based supplements or 'calmers' are available, which claim to enhance performance by reducing a horse's nervousness. However, there is a lack of qualitative or quantitative evaluation of their efficacy. This study investigated the impact on performance of feeding a calmer in experienced equestrian partnerships. Five warm-blood combinations were selected, 1.30 m + show-jumping n=2, 3\* eventing n=2, advanced dressage n=1, comprising 3 geldings and 2 mares. Horses had never used a calmer and all riders were experienced, mean 7.8±2.8 years. Riders completed a questionnaire rating temperament and 'rideability', using likert scales, at home, during competition warm-up and at events prior to feeding a chelated calcium calmer 'Cool, Calm & Collected®' as per manufacturer's instructions. A training diary was kept during the trial, questionnaires were repeated after 6 weeks and competition results were reviewed. Wilcoxon signed rank tests evaluated if differences existed in temperament and rideability ratings pre and post calmer administration. The variables aggression, irritability, dominance, quickness to learn and tries hard did not differ throughout the trial ( $P>0.05$ ). A number of temperament descriptors were rated as significantly improved at home, during competition warm-up and the event: skittish ( $P<0.003$ ), excitable ( $P<0.0008$ ), tense ( $P<0.003$ ) and panics easily ( $P<0.003$ ). Rideability improved across all scenarios ( $P<0.0006$ ); partnerships recorded significant improvement in competition results ( $P=0.003$ ). Qualitatively riders consistently commented that horses were more relaxed, less argumentative, more focused and exhibited enhanced performance levels when fed the calmer. It appears that the use of a calmer even in experienced partnerships has resulted in improved performance attributed by riders to changes in the psychological profile of their equine partners and evidenced by improved competition results. However, it is difficult to ascertain if a placebo effect occurred within the riders which could have also influenced performance. Further work using larger populations and placebos across experience and competitive levels.

**LP:** A horse's temperament can impact upon competitive performance. Calming supplements are often used to improve equine performance, yet there is limited evidence of the effectiveness of calming supplements. In five experienced combinations, competition results and rideability of horses improved with the use of a calmer but more work is needed to substantiate these results.

## The effect of stirrup type on rider lower leg position

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The horse-rider interface has received much interest over recent years. Rider position and stability is known to impact directly on the horses' physical welfare. Whilst practical and research attention has focussed on core stability, the rider's legs have been largely ignored. The ability to retain a stable lower leg is crucial to providing the horse with clear leg aids and achieving effective reinforcement through timely and sustained pressure release. There has been an exponential growth in the equestrian equipment, following challenges to the function and form of traditional items, use of alternative materials, increased awareness of rider safety and fashion. A variety of stirrup irons are now available, designed and marketed to ensure rider safety, support riders' joints and improve rider leg position. This study investigated the influence of stirrup type on the lower leg position for novice and experienced riders. Six novice and 6 experienced riders (3♀ and 3♂ in each group,  $28.4 \pm 6.12$  years) rode 6 different horses in 6 different stirrup types (flexible stirrup-, balance-, aluminium shaped foot-, lightweight-, bent leg- and hunting irons). The experiment took place in a 60 m x 40 m outdoor arena on a sand and rubber mix surface. Horses were ridden in trot along a 1 m wide lane made up of 3 3 m coloured poles on each side. All riders were photographed using an 8MP digital camera mounted on a tripod from a fixed position as they passed the pre-defined midpoint in the experimental lane. There were 3 replicates per condition. The ideal Ear Shoulder Hip Heel alignment (ESHH) was digitally marked onto each image and the deviation ( $^{\circ}$ ) of the rider's lower leg position from ESHH was determined using ImageJ™ image analysis software. Stirrup type did not influence rider leg position ( $F_{5,102}=0.92$ ;  $P>0.05$ ). However, lower leg position was influenced by rider ability ( $F_{1,96}=5.62$ ;  $P<0.05$ ) with novice riders displaying significantly greater deviation from the lower leg position if the correct ESHH is maintained ( $36.5 \pm 6.26^{\circ}$ ) than experienced riders ( $28.6 \pm 4.81^{\circ}$ ). Unsurprisingly, rider ability is the primary determinant of the maintenance of a correct and stable lower leg position. The type of stirrup iron used does not influence rider lower leg position despite manufacturers' claims.

**LP:** Rider ability is the best predictor of a correct and stable lower leg position, which largely adheres to Ear-Shoulder-Hip-Heel alignment. The type of stirrup iron used does not influence the rider's ability to maintain an accurate and consistent lower leg position. Riders should focus on achieving lower leg stability so they can give the horse clear signals and conduct effective pressure release. This will decrease the likelihood of occurrence of confusion and associated stress responses in the ridden horse.

## Do gloves have an impact on rein tension?

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The equestrian industry welcomes the development of horse and rider equipment designed to enhance training, riding and competitive success. Horse riders and handlers have marked preferences for both the equipment used on the horse and the clothing that they wear. Increasingly the development of equestrian wear is informed by emerging materials and sports science technology. Sustainable and ethical equitation relies upon the effective delivery and receipt of clear signals by the horse and timely pressure-release by the rider. The reins are one of the means by which delivery of signals is achieved. It is known that rein type can influence riders' grip, as does the wearing of gloves in other sports. This study aimed to determine the effect of wearing gloves when using different types of reins at different gaits. A Racewood equine simulator was located in a 3 m x 3.65 m stable and fitted with a Reincheck™ rein tension gauge. Nineteen subjects (7 novice, 4 intermediate and 7 experienced) rode the simulator, using leather, webbing and rubber reins, with and without gloves, for 10 seconds in each gait (walk, trot and canter). There were three replicates per condition. Mean rein tension data (N) were derived for each condition using SignalScribe™ software and analysed using non parametric statistical tests and parametric tests. Mean rein tension (N) was influenced by rider experience ( $H_2=110.1$ ,  $P<0.0001$ ); novice rider tensions (median=2.30N) were greater than those of intermediate riders (median=1.60N,  $q=3.65$ ;  $P<0.05$ ). Rein type influenced rein tension ( $H_2=17.4$ ;  $P<0.0001$ ) as did gait ( $H_2=7.54$ ;  $P<0.05$ ) with greater tension recorded with rubber reins than leather or webbing reins (2.21N, 1.95N and 1.65N respectively) and increasing from walk through to canter (medians=2.03N, 2.02N, 1.86N respectively). Significantly smaller rein tensions (median=1.85N) were evident when riding with gloves than without (median=2.03N,  $W=976403$ ;  $P<0.05$ ), particularly with intermediate (2.75N to 2.04N with gloves) and experienced riders (1.84N to 1.66N with gloves), regardless of rein type ( $F_{2,1938}=0.40$ ;  $P>0.05$ ). The materials used to manufacture reins used in equitation have a significant effect on rein tensions. However, gloves are worn ubiquitously within equestrianism. Glove wearing was associated with significantly reduced rein tensions which accords with the requirements of ethical and sustainable equitation to reduce the pressures that horses are subjected to, and to reduce signals to a light aid as quickly as possible during training.

**LP:** Riders exert less tension on the reins when wearing gloves than when riding bare handed. The use of gloves may contribute to the reduction of pressure on the horse and therefore contribute to the achievement of ethical and sustainable equitation and promote better welfare.

## **Health of riding school horses in Denmark: Clinical examination and evaluation of work intensity**

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Many people recognize life of riding school horses to be of a less attractive quality compared to private owned horses. Only limited data are available regarding the health of this equine subpopulation. The aim was to investigate the health status and workload of riding school horses. 105 riding school ponies (67%) and 51 horses (33%) of different breeds from 10 selected riding schools were included. One stallion, 65 mares and 88 geldings with a mean age  $13.5 \pm 4.4$  years underwent clinical examination including temperature, skin and hair coat, body condition, pulmonary, cardiac and gastrointestinal systems. The heart rate (HR) was measured using a heart rate monitor during riding school lessons. The body weight and height were also measured, and a blood sample was examined by standard hematological and biochemical profiles. The data were evaluated with descriptive statistics (including t-test) and tests for differences between ponies and horses and age groups. The data collection is still on-going, and results mentioned here are preliminary. At the time of examination, the horses had been working in the riding school for  $4.9 \pm 3.9$  years with 10% of the horses being engaged for more than 10 years. Generally, all horses were clinically healthy with only minor clinical signs of health disorders. 5.8% of the horses had minor skin lesions such as alopecia and crusts, and 17% were classified as overweight and 3% were underweight. Blood samples were mostly within normal levels with a few exceptions. Older horses had significantly lower red blood cell count compared to younger horses ( $P=0.02$ ). Good data quality of HR measurements during work was obtained in 85 horses and ponies. Average HR during exercise was  $73 \pm 13$  bpm. The relative workload which is an estimate of workload calculated by the average heart rate in the lesson divided by the estimated maximal heart rate of the horse ( $220 \text{ beats/min} - \text{the age of the horse}$ ) was  $35.0 \pm 6.0\%$ , which was low compared to other types of riding horses. No significant difference in working HR or working hours/week between horses and ponies was found. We conclude that the population studied here was in good clinical condition and the work intensity measured as working hours/week and HR during work were relatively low.

**LP:** Examination of 156 riding school horses divided at 10 riding schools in Denmark showed that the horses were generally healthy and the working requirement of the horses was relatively low.

## **The influence of human and equine laterality on competition results and risk of injury**

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The aim of the study was to investigate the distribution of equine laterality and the influence of equine and human laterality on competition results and risk of injury. A total of 686 riders (94 left-handed, 543 right-handed, 39 ambidextrous, 10 not specified) provided information about 1286 horses (684 right-, 512 left-lateralised) in an online-survey. The direction of laterality referred to the horse's preferred side for dressage tasks. Cross-tabulations of two characteristics with 2-25 values were investigated for random distribution using chi-square tests, phi and Cramer's-V in SPSS. The horse-rider-combination was surveyed by a single question. Regardless of the rider's handedness, left-lateralised horses were more common. However, left-handed riders showed a stronger preference for left-lateralised horses (43.6% vs. 23.4%) than right-handed riders (40.2 vs. 32.6%,  $P < 0.001$ ). Comparisons of laterality with other traits were based on the detailed description of 1197 horses. At high equestrian levels (German levels M-S), ambidextrous (33.3%) and left-handed riders (30.9%) were stronger represented than right-handed riders (22.5%,  $P < 0.001$ ), regardless of their horse's laterality. In competitions, left-handed riders achieved multiple wins most often (21 vs. 12%), whereas right-handed riders most often had just one win (7 vs. 5%) or remained unplaced (12 vs. 5%). Ambidextrous riders most often achieved one or more placings (28 vs. 26/22%,  $P < 0.001$ ). Right-handed riders reported more injuries in their dominant hand (19.7 vs. 10.7%). Left-handed riders injured their non-dominant hands more often than right-handed riders (14.9 vs. 10.7%). Ambidextrous riders remained uninjured most often (89.7%,  $P < 0.001$ ). The number of injuries of the preferred and non-preferred side was similar for left- and right-lateralised horses. Left-lateralised horses showed a tendency towards injuries of the non-preferred side and right-lateralised horses towards bilateral injuries. No further correlations of laterality and injuries between riders and their horses could be detected ( $P > 0.08$ ). Although being underrepresented in the population (15%), the results indicate an advantage of ambidextrous and left-handed humans concerning the equestrian level, competition results and risk of injury. Direction of laterality in the rider rather than the horse appears to be more important to equitation success and safety.

**LP:** Overall, left-lateralised horses seem to be slightly more prevalent. Left-handed riders clearly favoured left-lateralised horses. The dominant hands were injured most often. Ambidextrous riders seem less injury-prone. Right-handed riders were less successful in competitions and rode at lower levels than left-handed and ambidextrous riders.

## **Experience level of jockeys affects the use of the whip in Quarter Horse racing**

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The use of the whip in horse racing is being called into question as recent studies show no increase in racing speed with whip use. Although each racing association has rules regarding whip design and use, these may be written to appease public perception rather than with an eye to horse welfare. If jockeys rely more on experience, technique and strategy to win a race, they should be less reliant on the whip to encourage the best performance from their mount. It was hypothesized that jockeys with less race experience will use the whip more often during a race than more experienced jockeys. Jockeys were selected from the statistics of Ajax Downs Quarter Horse Racetrack (ON) and categorized as experienced (>800 starts in past four years; n=5) or inexperienced (<400 starts in past four years; n=5). Ten races per jockey (all 330 yards in length) were watched via online race replays and number of whip hits, whip hand used, location of hits, horse speed index (SI), finish time and placing were all recorded. Pearson correlations for each factor were calculated on jockey experience level, with SI included as a covariate on correlations for finish time and placing. The number of times a horse was whipped had no effect on finish time, placing or speed index ( $P>0.40$ ). Experienced jockeys whipped their horses significantly more often than inexperienced jockeys ( $12.35\pm3.8$  vs.  $7.86\pm2.9$  total whip hits, respectively;  $P<0.02$ ). Despite whipping their mounts more frequently, experienced jockeys did not tend to place higher ( $P>0.069$ ). There was no difference in whip hand used ( $P>0.41$ ) or location of whip strikes ( $P>0.12$ ) in the two classes of jockeys or on finish time or speed index. These results show that experienced jockeys struck their horses more often with the whip; however, their horses did not perform better, suggesting that an increased use of a whip in Quarter Horse racing has little effect on a horse's athletic performance.

**LP:** Quarter Horse jockeys with more racing experience use the whip more often during a race, however, the increased frequency of whip hits does not appear to improve the racing performance of the horse. Rules regarding whip use in horse racing should be reviewed with regards to horse welfare.

## Health of riding school horses in Denmark: Clinical examination of the locomotor system

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Orthopedic problems are the most common reason for sport horses to interrupt training and athletic career. Only limited data regarding orthopedic health in riding school horses are available. The study aimed at investigating the orthopedic health status in Danish riding school horses. The study included 10 riding schools with 66 mares, 89 geldings and one stallion. 105 (67%) were ponies and 51 (33%) were horses of various breeds, which were similar to the distribution in the Danish school horse population. On each horse, an orthopedic examination was performed including inspection of limb conformation and palpation of joints and tendons in all four limbs. Movement during walk and trot in a straight line, during trot on circles on both reins, and during trot after flexion tests was scored on a 0-5 scale (AAEP). History of previous lameness was obtained. Data were evaluated with descriptive statistics and tests for influence of factors such as age, workload, previous disease and differences between horses and ponies. Results are preliminary as data collection is still on-going. Mean age was  $13.5 \pm 4.4$  years. 22% of horses and 11% of ponies had a history of previous lameness. Limb conformation was generally good with mainly mild changes. On palpation of joints, 22% had effusion in one or more fetlock joints and 15% had effusion in one or both tarsocrural joints. 12% had reaction on palpation of the tendons. On inspection of the movement, mild lameness (grade 2) was observed in 5% and 10% of the cases during straight line trot and lunging, respectively, and slight gait irregularities suspicious of subtle lameness (grade 1) was observed in 8% and 15% during straight line trot and lunging, respectively. In straight line trot, the proportion with gait abnormalities was significantly larger in horses than in ponies ( $P=0.04$ ). With flexion tests, 37% showed slight increase in lameness (1 grade) and 18% showed obvious increase in lameness (2-3 grades). Horses with previous lameness history had a 9.2 higher risk of lameness than horses without previous lameness history ( $P=0.0016$ ). In the population of riding school horses studied, changes were mainly found in fetlock and hock joints. Few horses showed mild lameness, while more horses showed gait irregularities suspicious of subtle lameness. Further data collection will investigate if these cases will develop lameness.

**LP:** Orthopedic examination of 156 riding school horses at 10 riding schools in Denmark showed only mild lameness in few horses. Other predominant findings were increased amount of fluid in the fetlock and hock joints and reaction on flexion tests.

## **A pilot study to assess if interval training prepares the elite eventing horse for competition**

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Successful training regimes prepare athletes for the duration, intensity and specific skill tests competition presents. Despite advances in technology, equestrian training methodologies are based more on tradition than scientific methods. Eventing includes aerobic and anaerobic activity periods, the latter predominately during cross country. Mean heart rates (HR) of event horses in training do not mimic those in competition, suggesting training methods used are inappropriate. We explored if interval training prepared elite eventers for competition effectively. A case study methodology was employed to evaluate training regimes in 2 eventers. HR, speed (S), duration (T) and distance (D) data were collected via a Polar RC3 GPS unit for interval training sessions from July to Sept. 2013 (n=9 per horse). Horse 1 (H1) was aiming to complete its first CCI\*\* (2<sup>nd</sup> Oct.) and horse 2 (H2) an initial CCI3\*\*\* (12<sup>th</sup> Sept.). T (min) and D (km) of each session were noted alongside mean S and maximum S obtained within the session (min/km). Mean HR, maximum HR and the percentage of time spent in aerobic (HR <183bpm) and anaerobic activity (HR>184bpm) were also recorded. Paired t-tests evaluated if differences were present between the first and second halves of the training period for each horse. Descriptive data were plotted over time to explore training profiles for the period investigated. No differences were exposed for any variables within training (P>0.05). Regimens were similar for both horses: mean D H1: 11.5±3 km; H2: 12.5±1.5 km; mean T H1: 65±15 min; H2: 69±9 min. Mean HRs demonstrated predominately aerobic activity (H1: 120±8bpm; H2: 120±9bpm). Maximum HRs exceeded the anaerobic threshold (H1: 201±3bpm; H2: 204±3bpm) but this level was only maintained for 8±4% of training H1 and 11±4% H2. Maximum S's obtained were greater than competition requirements: 2\*: 1.83 min/km; H1: 1.41 min/km and 3\*: 1.75 min/km, H2: 1.57 min/km but mean S's were slower (H1: 5.1±0.6 min/km; H2: 5.3±0.9 min/km). Training profiles did not represent a progressive increase in physiological activity over time but varied throughout the period investigated. Both horses completed their target events; however, results suggest that whilst interval training prepared them for competition, it could potentially optimise performance more. Increasing the anaerobic component progressively within a regime, via a periodization approach, with reference to competition requirements might enhance eventers' competition performance.

**LP:** Training regimes in equestrianism are largely based on experience; analysing training more could improve horses' competition performance. Traditional interval training partially prepared event horses for 2\* and 3\* competition, but increasing anaerobic work progressively may improve this further.



## Effect of training on stress and rideability, and relationship with personality in young show jumping horses

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The aim of this study was to investigate the effect of training for show jumping on stress and rideability and relationship with personality (temperament). The personality of 24 horses (4 and 5 years old - mainly of French Saddle Breed) was assessed at the beginning of a 5 months training program by behavioural standardized tests measuring five temperament dimensions, including fearfulness. Behaviour of ridden horses was videotaped during 14 training sessions and 10 show jumping competitions. Salivary cortisol samples were taken immediately after the first and the last competitions. Wilcoxon signed rank tests (V) and Spearman correlations (r) were used to investigate behavioural evolution between the beginning and the end of training and to show relationship with personality. As expected, results show that horses were more stressed at the beginning of training rather than at the end (more often in alert posture:  $V=114.5$ ;  $P=0.017$ ), but surprisingly the behavioural and physiological indicators of stress (e.g. cortisol increases), did not differ between the first and the last competition. Horses were also more complicated to be ridden at the beginning of training than at the end (stronger rein tension,  $V=135$ ;  $P=0.031$ , lower responsiveness to riders' aids,  $V=40.5$ ;  $P=0.030$ ) and in competition (more rider interventions:  $V=182$ ;  $P<0.001$ ). Correlations with personality show that during the first training sessions, the most fearful individuals were more complicated to be ridden ( $r=0.50$ ;  $P=0.013$ ) and were more prone to swerve in front of the obstacle ( $r=0.60$ ;  $P=0.002$ ). In competition, they more often refused to jump ( $r=0.58$ ;  $P=0.001$ ) and swerved in front of the obstacle ( $r=0.64$ ;  $P=0.004$ ), but surprisingly they had the fewest penalties in all competitions ( $r=-0.60$ ;  $P=0.007$ ), because they are more careful.

**LP:** Young show-jumping horses were more stressed and complicated to ride at the beginning of 5 months training than at the end, but the behavioural and physiological indicators of stress did not change from the first competition to the last one. Horses with fearful personality were more complicated to be ridden but were also the most successful ones in show jumping competition.

## **A pilot study into the effects of various mounting techniques on the pressure of the horse's back**

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The aim of this study was to investigate the pressures on the horse's back when mounting from three heights (ground, 28 cm and 58 cm) to establish an ideal method for the welfare of the horse by comparing the pressures seen under the saddle with the use of an electronic pressure mat (Pliance System produced by Novel). Suggested limits for the horse's tolerance to pressure before sores and injury occur have previously been identified, and although this is higher than that of human tolerance, efforts should be made to avoid causing pressure above prescribed limits in any aspect of human:horse inter-action. The most obvious likelihood of this occurring is under the saddle, and whilst there have been studies into the effects of pressure whilst riding only one study could be found to identify the same in mounting. One rider (height of 175 cm) mounted the same horse (162 cm 'cob type'), with a well-fitting saddle, three times for each of the 12 techniques to obtain a mean value for each method. Mean overall pressure (KPa) under the saddle, mean peak pressure and maximum peak pressures were recorded using the Pliance System by a trained technician from the Society of Master Saddlers. No significant difference between methods ( $P>0.05$ ) was observed in overall mean pressure supporting previous studies on saddle fit and rider influence. However, both maximum and mean peak pressures varied significantly between the techniques ( $P<0.05$ ). The mean pressure under saddle varied greatly between the mounting methods with mounting from the ground in an unsupported fashion having the highest (4.43KPa) and the lower block self-supported method having the least (1.97KPa). In terms of peak pressure, the ground unsupported method was again the highest (18.61KPa) with mounting from the higher block self-supporting having the least (8.35KPa). These results suggested that mounting from the ground unsupported and self-supporting or counter balancing from the ground is also not ideal. The most preferential in this study that caused least pressure on the horse's back was mounting without the foot in the stirrups but simply swinging the right leg across the horse to find the opposite stirrup or by a self-supporting method where the rider holds the opposite stirrup leather as he/she mounts from a height of some 28 or 58 cm.

**LP:** How you regularly mount your horse may have health and welfare implications on its back health. This study suggested a preferential height and method where the rider does not place his/her foot into the stirrups first.

## **A pilot study into the effect of a GPS and treeless saddle on the temperature of the horse's back and its freedom of movement**

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Evidence of man riding horses with some sort of seat covering dates back to circa 4000BC. A treeless saddle has been found to date back to circa 500BC with treed saddles to around the same time. Saddles have been shown to improve the stability of the rider and performance of the horse. The aim of this study was to compare gait variations (shoulder angles and stride length) in two differing saddle types. A treed Wintec (GPS) and a treeless Total Contact Saddle (TCS) were used. The impact of heat variations on the back was also measured as this is a possible indicator of pain/inflammation. A random selection of six horses from a riding school population was chosen, and each horse was ridden by the same rider for 10 min in walk and trot in an indoor school. Temperature was recorded at the start of the activity by way of a digital thermocouple and every minute after from an area equivalent to that under the seat bones of the rider and on the horse's skin. The use of a high speed video camera (Sports Motion Video Analysis System) allowed stride characteristics to be taken from marked areas on the horse. A thermographic camera was also used to identify any 'hot spots' on the horse's back post exercise. The horses were first ridden in their own GPS saddle and then the Total Contact Saddle with a period of time between each effort to allow the horse's back to come back to a base level. A Wilcoxon Signed Ranks Test was used to analyse the data collected using SPSS software. The results indicated that the mean stride and shoulder angle range was greater in the Total Contact Saddle in both walk and trot ( $P=0.042$  and  $P=0.01$ , respectively – walk values: mean shoulder angles = 14.90 degree vs. 13.80 degree; mean stride lengths = 1.85 m vs. 1.80 m; trot values: 1.86 m vs. 1.80 m) and it also produced a significantly lower temperature figure in both walk and trot ( $P=0.04$  and  $P=0.026$ , respectively – mean walk temp = 33.5° C vs. 35.3° C and 32.4° C vs. 35.9° C. Whilst a potentially tissue damaging temperature of some 41° C was not reached at any time throughout the tests (mean temps in the GPS ranged from 34.2 to 36.2° C and in the Total Contact Saddle from 32.6 to 34.4° C) the exercise was only over 10 min and it might be hypothesised that a longer activity period and different environmental conditions may cause these to go much higher. The difference in stride parameters is of interest in dressage situations and potentially in jumping as well.

**LP:** This study investigated the relative merits of one type of treeless saddle and a GPS alternative in a controlled setting where the treeless saddle was shown to have better performance parameters for the horse.

## **Difference and relationship in length of the ‘mean’ canter stride of a horse and the intermediate strides within a two stride double fence combination**

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It has previously been shown the intermediate jumping strides of elite horses between two stride double fence combinations differed considerably, i.e. the first intermediate stride was longer than the second; although conducted at the same velocity (Hole et al., 2001, *App. Anim. Behav. Sci.* 75, 317-323). The aim of this study was to determine whether the mean length of a standard canter stride seen on the long side of the school had any relationship with the intermediate jumping strides. In addition, the study sought to find out if there was a significant difference between the lengths of the two intermediate strides in non-elite horses as has been shown in elite horses previously. A random selection of horse and rider pairings (n=6) were selected with horses aged between 8-20 years, heights between 155 cm and 164 cm. The only selection criterion was that they were capable of jumping the required combination. A double fence combination of 80 cm uprights was set up, 10 m apart within an indoor school. The riders were asked to canter down the long side of the school and jump through the combination three times. This was filmed using a Sports Motion Gait Analysis camera to determine stride length and define a mean of the attempts with the take-off and two intermediate strides measured. The results showed that there was a significant difference between the standard canter stride and the intermediate jumping strides (ANOVA,  $P < 0.001$ , mean standard canter = 3.05 m, mean 1<sup>st</sup> intermediate jumping stride = 4.12 m, mean 2<sup>nd</sup> intermediate jumping stride = 3.81 m). It was also found that there was a significant difference between the two intermediate jumping strides ( $P = 0.03$ ) with the second stride being shorter than the first. The length of canter stride values suggests that the horse's stride lengthens considerably in the jumping phase of show jumping activities possibly causing issues relating to judging distances regarding novice built training exercises. The horses showed different intermediate stride lengths; however, all making up the set distance in the combination through landing and take-off stride changes. This suggests that the same adaptation occurs in elite and non-elite horses, which has possible implications for course design at all levels.

**LP:** The difference between horses' stride lengths between a standard canter and between jumping combinations is considerable. An average canter stride of a horse lengthens significantly to that used when jumping. The intermediate strides between combinations of fences are to allow the horse to regain balance and momentum allowing for the next jumping effort to be tackled safely. The horse adapts its intermediate strides from that seen as a standard canter stride and the jumping stride with the second intermediate stride being shorter than the first.

## **A pilot investigation into the limb phasing characteristics and stride length of fully shod, partially shod and barefoot horses**

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The hooves of feral horses, untouched by humans, adapt to the terrain and environment to offer the horse the most energy cost-effective way to travel in all gaits. Horses used by man however are often shod in order to better deal with modern surfaces and demands placed upon them but little research has been undertaken on how shoeing affects the stride mechanics of the horse. The aim of this study was to identify if there were any significant differences in the limb phasing characteristics and symmetry of stride in fully shod, partially shod and unshod horses. A convenience sample of twelve unshod horses, six shod and six partially shod horses were recruited for this study. The horses were walked and trotted in hand for a distance of ten meters to collect data of their stride characteristics. The ETB Pegasus limb phasing system was used to determine limb temporal characteristics (sagittal and coronal cannon range and time in stride for maximum protraction and retraction of the forelimb and hind limb). Analysis of the results was done through a one-way ANOVA test. The results suggested that there was no significant difference in the individual stride duration at walk ( $P=0.291$ ) or trot ( $P=0.430$ ) between horses that were shod (s, mean= $1.14\pm0.29$  and  $0.67\pm0.17$ , respectively), partially shod (s, mean= $1.17\pm0.27$  and  $0.68\pm0.16$ , respectively) and unshod (s, mean= $1.21\pm0.05$  and  $0.71\pm0.02$ , respectively). Equally, data collected on the limb phasing characteristics (sagittal and coronal cannon range and time in stride for maximum protraction and retraction of the forelimb and hind limb) showed no noticeable differences between the different shoeing regimes. However, forelimb and hind limb analysis for overall symmetry values in the sagittal and coronal ranges at walk and trot returned results of  $P=0.34$  (walk) and  $P=0.04$  (trot). This may support the theory that farriery used as a tool to correct unbalanced limb conformation may be effective and that weight added to the distal forelimb appears to increase its range of motion. However, generally, the data suggests horses appear to adapt their stride pattern to accommodate a shod or unshod condition. Further study needs to be conducted to evaluate how a horse adapts to the removal and addition of shoes in order to test this further.

**LP:** The shoeing decisions of a horse owner may have implications for the identification of early signs of lameness and training effectiveness. This study did not show statistically significant differences between shoeing regimes, however, advice should be sought from a qualified applied equine podiatrist or farrier with an understanding of the movement idiosyncrasies surrounding each individual horse. Further research is needed.

## **An investigation into the ability of riders to obtain an ideal dressage position**

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The correct riding position is considered impactful for rider injury risk reduction and the welfare of the horse. A balanced rider position may reduce injury risk caused by rider falls and also help avoid musculoskeletal injuries to both the rider and horse. Considering the importance placed on rider position, research is sparse with rider position teaching methods being based on tradition rather than scientific research. The purpose of this study was to evaluate riders' ability to obtain a correct dressage position whilst sat on a dressage saddle, placed on a saddle horse, through comparison with their actual position. The correct position was considered to be with the shoulder, hip and heel vertically aligned (ESHH). Markers were placed on the lateral aspect of the right shoulder, hip and ankle joints. The subjects were instructed to mount the saddle horse and sit in the saddle in a position that they would maintain when riding a dressage test. The riders did not receive any verbal or visual feedback on their position. Images were taken from the right side, recorded using a digital camera. Rider position was analysed using Image J™ software where the distances between the shoulder and the vertical line, and the ankle and the vertical line were measured. The vertical line was drawn with the mid-point over the lateral aspect of the hip joint. Fifteen novice/non-competitive (NC) riders were compared with fifteen advanced/competitive riders (C). All riders (n=30) positioned their ankle in front of the vertical line and 27 (90%) riders had their shoulders behind the vertical line. There was no significant difference in the distance between the shoulder and vertical in the two groups (NC: mean 5.47±3.00 cm vs. C: 4.02±3.43 cm;  $t_{28}=0.17$ ;  $P>0.05$ ) and the ankle and vertical (NC: mean 8.71±5.52 cm vs. C: 8.68±5.16 cm;  $t_{28}=0.98$ ;  $P>0.05$ ). It is therefore suggested that rider experience does not influence the position maintained. The saddle may have had more influence on rider position rather than the experience of the rider. Analysis of each subjects' position in alternative styles of saddles would be the logical progression of this study.

**LP:** The position of the rider is important to reduce the risk of injury to both the horse and the rider. When sat in a dressage saddle, all riders had their legs in front of the vertical and most had their shoulders behind the vertical. Further study is needed to help better understand the effects of rider position and therefore improving the welfare of the horse.

## **Sustainable Model of a Performing Barefoot Horse Facility**

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The debate of horse shoeing versus barefoot trimming has been an on-going debate amongst the horse industry for several years. Horses have been domesticated for over six thousand years, partnering with man in work, travel, war and sport. The practice of shoeing horses appears in written records around 900 A.D and continued into the Middle Ages, when horses were housed in castles on damp surfaces compared to being outside on corrals. The equine industry perceives that barefoot horses cannot perform at the same level as shod horses. For this reason, they are willing to accept the application of shoes that impede the normal function of the hoof by interfering with natural circulation, peripheral loading, heel contraction and unbalanced digital axis. The purpose of this research is to show that barefoot horses can perform at the same level, if not better, than shod horses, by providing a successful barefoot husbandry and business model that is acceptable by the equine industry. The study compares two groups of horses selected with the same criteria, 35 barefoot and 35 shod, of different ages, breed and sex that have been kept in work for a period of 4 months. The horses were housed in different facilities, but with similar industry standards: Type of food, working surface, hours of turnout and housed in individual box stalls size  $13\text{ m}^2 \pm 2\text{ m}^2$ . Days of loss of work due to lameness, lost or loose shoes were recorded and evaluated. Statistically, significant analysis (Z Test  $P < 0.05$ ) showed that the mean of days out of work for the barefoot horses was 0.5 while for the shod horses was 1.5. This not only indicates that a barefoot horse does not lose more days of work than a shod horse, but also suggests that the contrary may be occurring – the shod horse is out of work more time than the barefoot horse. Furthermore, we compiled the costs of 20 hoof practitioners and determined that the barefoot horse is less expensive to keep than a shod horse. A full barefoot trimming is on average one third the cost of a fully shod horse, and the barefoot horse is trimmed less frequently than a shod horse is shod. The data collected in this research proves that barefoot husbandry can be a successful business model adoptable by facilities in today's equine industry. The purpose of this research is to facilitate the acceptance from the equine industry of those researches that considers barefoot riding a better option from a welfare point of view towards a more sustainable way of riding horses.

**LP:** It is more economical to keep a working barn of barefoot horses than shod horses. Shod horses lose more days of work due to shoeing related complication compared to the days barefoot horses lose due to hoof damaging issues. Furthermore, shod horses have higher farrier expenses making it less economical.

## The role of an alpha animal in changing environmental conditions

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The maintenance and development of conservation areas by grazing of big herbivores, such as Przewalski's Horses (*Equus ferus przewalskii*) are common praxis. When stallions are needed for breeding they are often removed from the groups without considering group compositions and individual social roles. However, alpha animals are needed for different functions as ensuring group stability and decision making in potentially dangerous situations in several species. To investigate the importance of the alpha stallion in a bachelor group, we observed the behaviour of five Przewalski's Horse stallions during the enlargement of their enclosure. We analysed the activity budgets and the neighbourhoods and recorded movement orders. We examined which animal took the initiative for exploring the new area and how traits such as social rank influenced the horses' behaviour. We also investigated the stress level of the horses while exploring a new area. Our results suggest that the alpha male is very important for a bachelor group, especially in changing environmental conditions. The alpha male had the highest level of connectedness within the group. When exploring the new environment, his position in the group changed from the last position, at the former environment, to the front position. Also the whole group behaviour changed when exploring the new area, the stallions showed reduced resting behaviour, increased feeding and did not stay close to each other. We found that the stress level of most horses rose only marginally during the first days on the new area with only the alpha male showing a significant stress level increase during the first day of the enclosure enlargement.

**LP:** The results of the study demonstrated that the alpha male had an outstanding position in the observed bachelor group. He is suggested to be very important for leading and guarding the group in changing environmental conditions. Whether this is true for alpha males in general needs to be tested on further groups in a follow up study.



## Factors influencing horse management practices

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Horse management is variable and dependent on several factors. It has been shown that the welfare of domesticated horses can be affected by a number of management factors resulting in development of stereotypic behaviour and compromised welfare. Horse owners may understand the effects of different management practices; however, the barriers that prevent implementation of that understanding have not yet been investigated. The aim of the present study was to investigate the factors influencing horse management practices in order to identify the barriers to adoption of welfare friendly management practices for horses. An online survey questionnaire was administered through the British Horse Society, online equine forums and social networking sites in summer 2013. A total of 406 (98% female, mean age 39 ( $SD=13$ ) years) horse owners participated in the study. The questionnaire was based on different cognitive behavioural models and investigated management practices such as amount of turnout, type of housing, amount of forage and concentrate feed and amount of movement provided. Furthermore, knowledge, management motivations, attitudes towards equine welfare, empathy towards horses, perception of risk factors compromising welfare, perceived confidence in managing horses, perceived social pressure and control over management practices were evaluated using 6-point likert-type scales. Data were analysed using regression models. Welfare-friendly horse management practices are mainly influenced by personal motives such as convenience, low maintenance and financial aspects ( $\beta=0.131$ ,  $t=2.9$ ,  $P=0.003$ ), knowledge of equine welfare ( $\beta=0.259$ ,  $t=5.6$ ,  $P<0.01$ ) and social pressure ( $\beta=-0.304$ ,  $t=-6.5$ ,  $P<0.001$ ). All predictor variables explained 27% of the model's variance. Social pressure played a significant role for individual management practices such as feeding forage ( $\beta=-0.196$ ,  $t=3.3$ ,  $P=0.001$ ) and concentrate feed ( $\beta=-0.336$ ,  $t=-5.6$ ,  $P<0.001$ ). Perceived social pressure, including the influence of other people especially for yard stabling owners, clearly plays an important role in the management of horses. The greatest barrier to welfare-friendly management practices appears to be the management of the yard and how much control horse owners have over yard management practices.

**LP:** Social pressure and factors such as convenience and low maintenance seem to be the driving forces for horse owner's management practices. These factors should be taken into account when implementing new management techniques.

## **Equine assisted leadership training seminars – customer evaluation, market overview and use of horses**

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Equine assisted leadership training seminars (EALS) increasingly gain popularity. However, a wide variety of organizations exist, and there are no universally accepted accreditation procedures. The aim of the present, explorative study was to provide an overview of organizations offering EALS in one sample country (Germany). Using an internet and classified directory search, from February to June 2012 a total of 202 organisations offering EALS were identified. A telephone survey (n=120; response rate 42% (n=50)) among the identified organizations revealed a very heterogeneous structure of the organizations. Thirty-six per cent of the surveyed providers were certified according to the European Association for Horse Assisted Education (EAHAE), while the remainders were members of one of two national organizations (EQ-Pferd or BDVT) or not associated with any organization. The majority of seminars require participants among others to guide horses either with or without a lead rope, and focus on at least one of the topics personality development (66%), self-reflexion and feedback (62%), leadership skills (50%) and/or communication skills (40%). Half of the trainers had a history of offering EALS for less than 4 years, while 8% offered EALS for more than ten years (maximum: 16 years). The number of offered seminars generally ranged from 1 to 15 seminars annually (median 6), although one provider offered as much as 52 seminars per year, using either own or rented horses. The number of horses involved per seminar ranged from 1 to 16 with a median of 4 horses. Median fees for seminars were 500€ (range: 80€ - 1850€) per day, with EALS being for 18% of the providers the main source of income. Median annual revenue (n=27 responses) from EALS was 15,000€, ranging from 1,000€ to 220,000€ per provider. Based on a regression analysis, the key factors determining economic success were the experience of the provider, the target group (managers rather than private persons), and the age of the trainer. Taken together, the above figures indicate that individual horses generally do not participate frequently in EALS, which is in accordance with EAHAE guidelines. Thus, limited long-term effects on horses' welfare or their interaction with people are to be expected. Nevertheless, further research into horses' reaction to such repeated exposure to people inexperienced in horse handling using e.g. incongruent signals for communication would be interesting to study.

**LP:** Equine assisted leadership seminars (EALS) constitute a young and very heterogeneous market, lacking universally accepted standards. Individual horses' use is generally limited to simple leading and human-interaction tasks at low annual frequencies.

## **A preliminary investigation into environmental temperature and relative humidity during international transportation of sport horses**

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The globalisation of the equine industry has led to a substantial increase in the transportation of sport horses. Research to date has primarily focused on the impact of transportation on health and welfare however, there is currently very little research investigating the environmental conditions experienced during the transportation of sport horses. This preliminary study set out to record and analyse the ambient temperature (°C) and relative humidity (%) in seven horse boxes, transporting a total of eighteen horses during the journey back from an FEI CCI\*\*\*\* event in Pau, France to the UK. The journey consisted of approximately 20.50 hours of road transport and 1.50 hours of ferry transport, over a total mean distance of  $1401.14 \pm 100.62$  km. No significant difference in overall temperature between the road and ferry stages of the journey was found ( $P > 0.05$ ). However, as the journey was lengthy and incorporated travel during both day and night, this was perhaps a surprising finding. A difference in relative humidity, however, was found between horse boxes for the whole journey ( $P < 0.001$ ), the ferry journey ( $P < 0.001$ ) and when comparing road travel in France to the ferry journey ( $P = 0.037$ ). The mean relative humidity levels obtained for the entire journey were found to be 74.62% ( $\pm 4.43$ ); however, these levels increased during ferry travel (mean 80.67% ( $\pm 7.01$ )). Heat and humidity levels seen in individual horse boxes varied considerably during the journey and depending on type of travel (road vs. ferry). These changes may be due to differences in individual horse box design and the impact on ventilation and air flow. However, further research is needed to establish the implications of horse box design and to develop optimal travel conditions for sport horses.

**LP:** Heat and humidity levels in individual horse boxes were found to vary considerably during the journey with differences according to the stage of the journey. Humidity levels were found to be highest during ferry travel and variations between horse boxes for both temperature and humidity levels were found. Further research needs to be carried out to establish optimal travel conditions for sport horses.

## The use of pressure algometry to evaluate the immediate effects of sports massage in riding school horses

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Equine sport massage therapy is a growing business; however, there is a lack of scientific research in relation to the effects on ridden horses. The aim of this research was to investigate whether there were any changes to muscle tenderness in riding school horses before and immediately after treatment. Sixteen sound and healthy horses were used following veterinary consent and were randomly assigned to a control or treatment group. The pressure threshold of each horse was determined using an electronic pressure algometer placed on eighteen bilaterally symmetrical anatomical landmarks (stress points) along the neck and back muscles. Pressure was applied three times at an even rate and terminated when each horse exhibited a local avoidance reaction. Pressure thresholds were found to be repeatable ( $r=0.80$ ,  $P<0.001$ ). Horses were then treated or not according on group allocation and re-tested using the same examiner forty-five minutes later. No significant differences in initial pressure tolerance were found between groups ( $P>0.05$ ). When the treatment group was analysed, post massage results showed significantly lower pressure tolerance ( $P<0.01$ ) on the left side ( $2.61\pm0.13$  kg) compared to the right side ( $2.90\pm0.12$  kg) for stress point 1 (*rectus capitus lateralis*); stress point 8 ( $P=0.03$ ), the *Iliocostalis*, ( $2.72\pm0.17$  kg compared to  $3.07\pm0.15$  kg); and stress point 9 ( $P=0.04$ ); located at the junction of the superficial gluteal muscle and *longissimus dorsi* ( $3.36\pm0.19$  kg compared to  $3.66\pm0.22$  kg). A left side increase in pressure tolerance ( $P=0.04$ ) was also found post massage for stress point 3 (*serratus cervi*) (from  $3.41\pm0.17$  kg to  $3.62\pm0.18$  kg). These findings are interesting as they suggest that muscle tenderness in some stress points may have increased post treatment. Furthermore, there was a positive correlation between age and pressure tolerance ( $R_s=0.497$ ;  $P=0.05$ ) with older horses exhibiting higher pressure thresholds than younger horses. The reasons for this are not clear but suggest evidence of a learned response in the older horses or alternatively, younger horses were exhibiting a degree of muscle tenderness. The change in pressure tolerance and variations found in some regions between sides of the ridden horses are interesting considering normal handling and equitation practices. The higher pressure tolerance reported in the older horses compared to the younger horses also warrants further research.

**LP:** Sports massage had an immediate effect on a number of specific regions of the horses' neck and back and changes in pressure thresholds after treatment were found. Older horses tolerated more pressure than their younger counterparts but the reasons for this finding are still unclear.

## **Response of light horse breeds to humans in differing physical and mental states**

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Equine-assisted therapy (EAT) is useful for human participants to overcome physical or emotional trauma. Such participants unfamiliar with horses may involuntarily emit physiological fear or distress signals such as increased respiratory or heart rates (HR). Interpreting how horses respond to these messages is important for safety and to ensure a positive experience for both human and horse. Recent research in this lab demonstrated behavioural and physiological differences in draft horses exposed to humans with elevated heart rates due to physical exercise versus psychologically-induced elevations due to fear of horses. Other research has shown distinct differences in personality and reactivity among horse breeds, thus we wished to test repeatability of results using light horse breeds and the identical experimental protocol. Horses (n=8) loose individually in a round pen were randomly allocated to each of four treatments in mixed order: 1) no human [CONTROL]; 2) calm human comfortable around horses [CALM]; 3) physically-stressed human [PHYS; human exercised by stationary jumping to 70% maximum HR]; and 4) psychologically-stressed human due to fear of horses [PSYCH]. Both humans and horses were equipped with a HR monitor recording at 5 sec intervals. One female human was used repeatedly for all PHYS and CALM trials, and 5 female and 3 male (two of which had participated in initial study) volunteers were used once each for the PSYCH trials. Humans individually stood motionless in the centre of the round pen for 5 min while behavioural observations of the horse [gait, head position relative to the withers, distance and orientation toward human, orientation of horse's ears] were recorded every 5 sec. Each nervous human (n=8) was used once while the calm human was used for all PHYS and CALM trials. A mixed model analysis with horse and human as random effects was used to analyse the data. As with the draft horses, all horses moved faster around the pen in CONTROL ( $P<0.001$ ), possibly indicating stress at being alone. Horses moved slowest ( $P<0.018$ ) and had lowest HR ( $P<0.001$ ) in PHYS while human HR was lowest when the horse was touching the human ( $P<0.002$ ). This may indicate that light horse breeds respond best to humans who are exercised but mentally calm and that humans respond positively to touch, the implications of which may be used to improve EAT programs.

**LP:** Human-horse interactions are the basis of Equine-assisted therapy. Participants are often unfamiliar with horses and may be at risk of injury if their actions are inappropriately perceived by the horse. Understanding how horses react to different human physiological states may assist facilitators in providing safe and positive experiences for both the human and horse.

## Developing a feedback system for welfare assessments in horses

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A cycle of welfare assessment, feedback of results and improvement of housing and management will contribute to a better horse welfare. Feedback needs to be transparent and accessible and apart from results of assessment measures, may also include background information and advice on welfare improvements. Developing a system to deliver usable and effective feedback from horse welfare assessments to owners is the challenging aim of the present study. During the winter of 2014, 22 stables and 451 horses were assessed with a protocol that was developed for horses and based on the Welfare Quality® system. Both animal based measures, such as Body Condition Score and resource based measures, such as box size were included in the protocol. After the assessment, managers and/or owners were asked how they currently accessed/retrieved information on horse welfare and related housing and management regimes and what factors would be most influential to make them improve the current situation. We also enquired about the way they would like to receive information on the outcomes of the assessments. Responses were given from 13 of the 22 stables. The answers showed that 38% retrieved information from popular science articles in horse magazines, 77% from discussions with peers while 8% generally perceived their peers to lack knowledge on horse welfare. When asked what factors affect decision making around alterations in management regimes 85% answered horse health as the main factor and 38% answered economy. Out of the 13 stables, 85% wanted exhaustive information and advice on improvements, 69% preferred to get feedback as a digital document and 92% were interested in benchmarking their stables' results with those of other stables. On the basis of the 13 responses from the questionnaire, two types of feedback is given to the 22 stables in the study; one with assessment outcomes, background information, possible improvement strategies and benchmark information and one with limited explanation or advice. All 22 stables will be reassessed during the fall of 2014 to determine if and how the feedback influenced the actual welfare of the horses.

**LP:** Horse welfare is for an important part determined by the way owners house and manage their animals. Systematic measurements of welfare can help to identify possible improvements in housing and management. Welfare assessments were carried out and owners and stable managers were asked what information they would like and in what form in order to help them to take informed decisions regarding the improvement of their horses' welfare. In a follow-up study different forms of feedback will be tested.

## **Characteristics of Australian Thoroughbred Jumps Racing in 2012 and 2013**

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This study presents key descriptive characteristics about Australian thoroughbred jump racing derived from analysis of official stewards and Jump Review Panel reports of races during the 2012 and 2013 jump race seasons. Jump racing has been in existence in Australia for over 180 years but is currently conducted in only two states, Victoria and South Australia, where it remains of cultural, economic and social significance to particular communities. Jump racing has direct bearing on important issues in thoroughbred racing relating to horse welfare, economic viability and regional racing cultures and is the subject of a polarised debate between supporters and opponents of the sport. Jumping racing is conducted over the Australian autumn and winter months between late March and September. The aim of this study was to establish baseline time-series data about jump racing including horse numbers, horse starts per season, horse turnover, jockey and trainer numbers. The number of jumping race horses who started in Victoria was 195 in 2013 and 169 in 2012. In South Australia, 77 jumping horses started in 2013 and in 2012 there were 80 jumping horses. Around 20% of horses who start a race fail to finish due to injury, fatigue or a fall. There were 6 horse fatalities in 2012 (a rate of 0.85% of starters) and 4 fatalities in 2013 (0.73% of starters). Turnover rates of horses between 2012 and 2013 seasons were high. Only 33% of horses jumping in Victoria in 2012 started in jump races in 2013. In South Australia, this proportion was 22%. In Victoria around 50% of all jumping horses start 2 or less times per season and 66% race less than 3 times a season. For South Australia, around 80% of jumping horses start 3 times or less per season. In 2013 season, 34 horses competed in both states, involving significant overland travel. A total of 27 jockeys were involved in jumping racing in both seasons, and all jockeys rode in both states for a total of 119 trainers. Australian jump racing is presently sustained by the entry each season of a high number of new horses who start less than 3 times. Key characteristics of the jumping race industry compared to flat racing include low jockey and trainer numbers and long distances travelled between races.

**LP:** Australian jump racing in 2012-13 had a high turnover rate of horses, with a majority racing three times or less.

## **A non-invasive method for the detection of damage and changes in the hoof capsule**

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Horses may suffer from the presence of abscesses, cracks and keratomes in the hooves. This project is a feasibility study to investigate if existing material sensors can be used as a non-invasive, non-destructive method to help veterinaries/farriers getting a better knowledge of 1) the exact location and extent of abscesses, 2) the depth and length of cracks, 3) the size of keratomes. The method is based on the ability of the hoof to conduct heat. Utilizing the Hot Disk Sensors and method developed in ISO22007-2, with a novel computational procedure, the variations of thermal conductivity versus depth from a surface can be measured. Sub-surface structural variations can be monitored in a non-destructive manner. Applications can be found in a range of areas. For instance, verifying homogeneity of structure versus depth. The sensor, and its holder, has approximately the shape and size of a stethoscope. It is thus an object that a farrier/veterinary can handle with ease. An area of about one square inch of the hoof is heated 1-2 degrees with a single step-wise heat pulse. The thermal depth of probing follows a relationship:  $d=2at$ , where  $d$  represents the thermal depth of probing (from the sensor position into the hoof),  $a$  represents the weighted average of the thermal diffusivity of the hoof (from the surface position to the position  $d$ ), and  $t$  represents test time. Hence, the depth position can be determined for the different time positions. A typical time for measuring to a depth of 10 mm in a hoof capsule is 160 seconds. So far, tests in laboratory environment have established that the existing equipment works on the material that a hoof capsule consists of. Tests have been done on hoof capsules from dead horses, 3D-printed model hooves and the hooves of one live horse at a veterinary clinic. All results are reproducible. Results show the curve of the thermal conductivity versus depth changing when the heat flow reaches a place where there is an inhomogeneity in the hoof. To conclude, tests indicate the method being able to detect inhomogeneities in hooves. Further measurements will be needed to show the exact response of different problems in the hooves.

**LP:** The method offers a possible new non-invasive, non-destructive method of finding the position and extent of abscesses, cracks and other inhomogeneities in hooves. The technique is well established in other areas of material studies and based on the analysis of thermal convection and diffusion.



## 24-hour shelter use of individually kept horses during Swedish summer

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The need to provide outdoor summer shelter for horses in temperate climates for protection from heat and insects is barely considered although providing shelter during winter is a requirement. We observed horses' 24-hour shelter seeking behaviour during the summer giving horses the option to choose between three shelter types: A) closed shelter with roof and wind nets on three sides, B) open shelter with roof and opaque plastic opposite the entrance and C) shelter without roof but with wind nets on three sides. Shelters A and B were placed 5 m apart in one paddock; shelters A and C in the adjacent paddock. Eight Warm-blood riding horses were habituated to the shelters during one week prior to this study. Six of the horses were familiar with the shelters from a previous study. Horses were on summer pasture with access to natural shelter (forest) day and night. For testing, horses were kept individually in 20 x 40 m paddocks from 1600 on day one until 1600 the following day. During the night (10 h), shelter use was analysed from video recordings, whereas daytime shelter use (6 h) was observed live. Activity was recorded at 5-min intervals from 0900-1600. Insects (flies) were caught with sticky traps placed inside the shelters and outside the paddocks (control). Data were analysed with Proc Mixed and Glimmix procedure for Generalized Linear Mixed Models in SAS. Day temperature was LSM 20° C ±2 SE (night: 15° C ±3), relative humidity 56% ±10 (night: 73±8) and THI index 65±3 (night: 58±4). Seven horses used the shelters (in min) with roof frequently both during night (A: 61±72; B: 176±79) and day (A: 71±43; B: 112±48) whereas shelter C was visited least (<10 min). Shelter B was preferred ( $P<0.01$ ) and shelter use did not differ between night and day ( $P=0.49$ ). Horses used shelters significantly more often with increasing humidity and THI ( $P<0.05$ ). The number of flies caught was low (max 8/day in control trap) and did not differ between shelter types ( $P>0.05$ ). Shelter use had a significant effect on the frequency of insect defensive behaviour (tail swish, shake, skin shiver, ear flick,  $P<0.01$ ). In conclusion, horses make use of shelters during night and day even when climatic conditions are moderate. Shelters with a roof were clearly preferred and may have the potential to reduce insect defensive behaviour.

**LP:** Horses do utilize artificial shelters when given the possibility during summer. This could be considered when managing horses kept on otherwise plain pastures where there is no access to natural shelter such as trees.

## **A comparative study to determine if the use of stallion dung can change the defecation behaviour of stabled mares and geldings**

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According to the British Horse Society the average livery costs per horse in the UK are circa £5,200 with an additional figure of circa £550 for the average cost of bedding per horse. This study was established to identify if the placing of stallion dung into the stables of mares and geldings would change their defecation behaviour. The differences between mares and geldings were examined to determine if differences exist. A random sample of mares and geldings (n=5 of each) was recruited from a riding school population that were stabled for most of the day (box size: 3.6 x 3.6 m). Preferred defecation sites were identified for two days and recorded. Stallion dung was then added to the right hand side of the stable only so as to identify specific changes in behaviour and changes in defecation patterns and recorded for seven days. These changes were then further recorded for two days to identify the longer term effect without the stallion dung. Percentage changes to defecation sites were identified. The results of the trial period indicated a marked change of defecation behaviour with mares recording a change of 20% more defecation towards the middle of the stable area and 57% to the right hand side and geldings 50% and 157% more defecation, respectively. All horses showed a lack of interest in defecating in the left hand side at all. In the two days after the stallion dung was removed, the behaviour modification was identified as a 7% increase in the mare's movement to the middle, no change in the right hand side preference with the geldings showing a continued 56% increase to the middle and a fall of some 8% from the right hand side. These results clearly showed a marked pattern of change during the trial period which continued, albeit it at a different rate, for the two days after stallion dung removal suggesting that an effect was observed. The difference between mares and geldings was interesting as it has previously been reported that mares do not engage in marking behaviour but did in this study. This may be due to the horses being able to see each other in the stable system used and it has been reported that this may encourage defecation in a mare population. The number of faecal piles for mares and geldings was similar throughout the study period. However, the changes in behaviour supported the study view that defecation behaviour could be modified and so costs cut where stallion dung was available and used in this way.

**LP:** With increasing costs in the care of horses it seems sensible to identify costs savings wherever they may be without compromising the health of the horses in one's care. This study suggested that it may be possible to save bedding costs by adaptation of the horse's natural defecation patterns.

## Correlation of estimated weight to scale weight in draft horses

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Body weight is a common measure used for welfare assessment and daily management routines such as feed ration formulation and medication dosages. Since very few horse farms have scales for weighing horses and the weight of a horse is the primary information required to formulate feed rations and dosages, a body weight estimation formula is often used. It has been suggested that this formula does not accurately measure the weight of various body types and breeds of horses. Another method for determining body weight in horses is the body condition scoring (BCS) scale, which estimates body fat to assess body weight. The accuracy of either a calculated formula or BCS was compared to actual scale measurements of nine mature draft horses (6 Percheron, 1 Percheron x Friesian, 1 Shire, 1 Clydesdale). Each horse's heart-girth was measured in centimetres posterior to the elbows, over the sternum, with the tape measure as vertical as possible and crossing the middle of the withers, and body length was measured in centimetres from the point of the shoulder to the point of the buttocks. Weight was calculated in kilograms using the formula  $(\text{heart-girth}^2 \times \text{length})/11800$ . Each horse was then measured on an electronic livestock scale (Salter Brecknell). Finally, the BCS (scale 1-9; 1=poor and 9=extremely fat) of each horse was determined by an independent observer using photographs. Pearson correlations between scale weight, calculated weight and BCS were calculated in SPSS. For four horses, the scale weight was higher than the calculated weight and for five horses the reverse was true. The average scale weight was  $750.9 \pm 78.2$  kg and the average calculated weight was  $768.1 \pm 107.6$  kg. The difference of 17.2 kg was 2.3% of the average scale weight. The coefficient of correlation between the scale weight and calculated weight was 0.975 ( $P < 0.0001$ ). The coefficient of correlation between BCS and scale (0.229) or calculated weight (0.058) was not significant ( $P > 0.55$ ). Thus, the body weight formula provides an accurate estimation of body weight of draft horses with a high degree of reliability, whereas BCS does not appear to be correlated to body weight.

**LP:** The formula  $(\text{heart-girth}^2 \times \text{length})/11800$  used to determine body weight in kg is accurately correlated to actual weigh scale measurements and can be used to reliably estimate body weight of horses. However, body condition scoring is not a reliable estimator of body weight.

## **Assessment of personality of young jumping saddle horses and ponies: validation of simple tests performed during breeding evaluation**

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Personality (temperament) is an important factor when working with horses. Standardised behavioural tests have been developed in our laboratory to measure five personality dimensions on horses in a test pen, but these tests are not easily usable for measuring many horses gathered for one day during breeding evaluation. The aim of this study was to validate behavioural observations made during 1) simple tests adapted from those tests for horses led by bridle and 2) typical parts of breeding evaluation of young jumping horses, for assessing personality. Forty-two horses and ponies (3-5 years old) were first submitted to standardised personality tests, free in a pen, to measure fearfulness/curiosity (novel object, crossing a novel surface, suddenness test), gregariousness, reactivity/curiosity to a non-familiar human, tactile sensitivity and locomotor activity (Standardised Personality Tests (SPT)). Then, behavioural observations, that could give information on some dimensions and reactivity, were recorded on these horses by the experimenters, in the context of a breeding evaluation. They were performed during 1) typical parts of the evaluation (height measurement with a stick at withers, free jumping, conformation judgement) (Typical) and 2) additional tests on horses led by bridle to evaluate tactile sensitivity and fearfulness (walking around a novel object, walking on a novel surface, suddenness test) (Additional Tests (AT)). Spearman correlations were more numerous between SPT and the corresponding AT (SPT and AT reactions to tactile tests:  $r=0.40$ ,  $P=0.01$ ; SPT and AT reactions to the novel surface:  $r=0.43$ ,  $P<0.01$ ; SPT and AT reactions to suddenness:  $r=0.47$ ,  $P<0.01$ ) than between SPT and Typical (only reactions to Typical height measurements were correlated with SPT tactile sensitivity and SPT reaction to suddenness,  $r=0.45$ ,  $P<0.01$  and  $r=0.44$ ,  $P<0.01$ , respectively).

**LP:** Behavioural indicators of personality dimension and reactivity measured during typical parts of jumping horses breeding evaluation and during additional tests have been compared to more standardised personality tests. The additional tests measuring tactile sensitivity and fearfulness were correlated to the standardised personality tests. It is more difficult to understand which dimensions could be involved in the behaviour expressed during the typical parts of the breeding evaluation (height measurement, jumping and conformation judgement).

## Investigation into Nocturnal Behaviour of *Equus Caballus* in Different Stable Designs

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The majority of working horses are stabled overnight but little is known about how different stable designs, which may affect aspects such as access to social contact, may affect sleep behaviour. Any differences could have implications on welfare and the horses' ability to perform optimally. This study investigated whether barred or solid walled stables resulted in different nocturnal behavioural patterns including; position in the stable, recumbent and standing sleep, foraging and social behaviour. Twelve riding school horses (multiple breeds and sexes, age range of 10 years, all bedded on straw) were observed from 22:00 to 07:00 using an infrared CCTV system for two consecutive nights each. Six horses were housed in stables with barred walls (S1); six were housed in stables with solid walls (S2). Differences between total duration of behaviour for S1 and S2 were analysed using the Independent T-test ( $P \leq 0.05$ ) in IBM SPSS<sup>21</sup>. There was a significant difference ( $t=2.436$ ,  $P < 0.05$ ) for drowsing behaviour in S2 (mean  $137.5 \pm 68.6$  minutes) compared with S1 horses (mean  $288.7 \pm 135.6$  minutes). No other significant differences were observed; however, non-statistical analysis revealed a higher duration of wall-orientated behaviour in barred stables and recumbency behaviour in solid wall stables. Horses appear to be more vigilant when they can see a neighbour and display reduced lateral recumbency, which appears to be compensated for by increased standing sleep. These patterns suggest that the walled stables facilitate better nocturnal behaviour patterns in terms of Rapid Eye Movement (REM) sleep which is beneficial to equine welfare. Future studies might extend this research to use a cross-over design to further test influence of stable design but clearly more research is needed to establish optimal conditions for when the stable light is turned off.

**LP:** Stables with solid walls between neighbours can positively influence the nocturnal behaviour profiles of domestic horses compared to barred stable walls. Owners are encouraged to consider how such differences may affect the quality of their horses' sleep and the consequences regarding welfare and performance.

## Effectiveness of Cleaning and Bacterial Growth in the Equine Sheath

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A horse's sheath often contains a waxy build-up of smegma. This study is designed to determine if cleaning negatively affects the horse and determine if there are anti-microbial peptides in the smegma that are removed after cleaning the sheath. Nineteen horses were used in the experiment and divided into 4 groups: control, water rinse, Excalibur and baby shampoo. Horses were swabbed before cleaning and after cleaning. The swabs were inoculated on 3 different medias; MacConkey, Pseudomonas Isolation and Nutrient. The plates were incubated for 48 hours at 37° C and bacteria colonies were counted. Cleaning and testing was done 3 times with 3 weeks between cleanings. Each horse had significantly less bacterial growth before cleaning than following cleaning. The samples ranged from 10 times to 100+ times more bacteria after cleaning. The horses cleaned with Excalibur had the most increase in bacterial numbers. The horses cleaned with water had the least bacterial number increase. In subsequent cleanings, there was an increase in the number of bacteria both before and after cleaning as compared to the first cleaning. Smegma fully returned in the 3 weeks between washing. The bacteria identified did not pose a direct threat to the horses but some were related to urinary tract infections and were not natural. Smegma was collected for protein isolation. One gram of smegma was used and proteins were extracted using Qproteome Mammalian Protein Preparation kit. The proteins were analysed using SDS-PAGE. The proteins isolated were estimated to have molecular weights of 39 to 60. Experiments are in progress to test the proteins for anti-microbial properties and identification. It is possible that the smegma and bean serve as physiological advantage. The secretions form as a response from the skin of the sheath. It is possible smegma protects against pathogens. Cleaning the sheath can cause a response from the body increasing smegma build-up. Cleaning the sheath and removing a bean from the urethra may be unnecessary and cause irritation. This is supported by observations collected by Dr. Susan McDonnell at the New Bolton Center, University of Pennsylvania, United States. Five stallions coming from the feral heard and castrated from 3-5 years prior examination and 2 stallion castrated 8 weeks prior examination were found without bean or malodorous smegma build-up. The geldings have not had any attention to their penis since birth. This concludes that smegma problems may result from human contact with the sheath.

**LP:** Cleaning a horse's sheath causes an increase of bacteria, is unnecessary and removes important anti-bacterial proteins from the sheath.

## **Impact from subspecies of rose-hip (*Rosa canina*) on working capacity, serum vitamin C concentrations and behaviour of horses exposed to strenuous exercise**

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A galactolipid (GOPO) with strong anti-inflammatory properties was recently isolated from a specific subspecies of Rose-hip, and reported to up-regulate the genes responsible for the generation of collagen and aggrecan; two important elements of cartilage. The aim of this study was to test if a commercial powder, produced from seeds and shells of this subspecies of Rose-hip (LitoVet, Hyben-Vital) has any impact on working capacity, serum vitamin C concentration and behaviour of horses exposed to strenuous exercise. Sixty trotters ( $6.9 \pm 2.2$  years) were included in this double-blind, placebo-controlled and randomized trial, which lasted for 3 months. Forty-four horses were given either LitoVet (210 gram/day) or a similar amount of placebo. Working capacity was tested by calculating the time to run a 1000 meter course, and behaviour of horses was evaluated by a simple questionnaire answered by the trainers (yes/no principle). A subfraction of horses ( $n=16$ ) was allocated to treatment with either 50 or 25 gram of LitoVet daily – to be tested for serum vitamin C concentrations (photometric methodology) and anti-oxidative capacity (chemiluminescence). Non-parametric statistics was used to evaluate treatment differences. The time to run a 1000 meter course declined as a result of LitoVet supplementation (Initial time (sec), mean $\pm$ se:  $78.3 \pm 2.6$  vs.  $77.2 \pm 2.4$  after three months of treatment,  $P < 0.02$ ). The corresponding placebo values were:  $77.0 \pm 2.1$  vs.  $77.3 \pm 2.3$ ,  $P > 0.05$ ). The trainers' evaluation of litheness and if the horses were easier to work with the day after strenuous exercise, came out in favour of the treatment (70% positive responders vs. 53% positive responders in the placebo group). Supplementation of 50 gram of LitoVet resulted in a significant increase in serum vitamin C concentrations when measured after 14 days of treatment (Initial concentration (umol/l)  $18.5 \pm 5.5$  vs.  $21.4 \pm 7.4$  after treatment;  $P < 0.02$ ). This improvement was significantly higher than that observed in the group given 25 gram of LitoVet daily (Initial concentration (umol/l)  $20.0 \pm 4.3$  vs.  $18.8 \pm 3.5$  after treatment,  $P > 0.05$ ). An identical pattern, with the same concentration of significance, was observed when testing anti-oxidative capacity. In conclusion, our results indicate that a feed supplement containing a sup-species of Rose-hip improves working capacity and elevates serum vitamin C concentrations. The data also indicate that horses receiving this feed supplement may be more lithe and easy to work with the day after strenuous exercise. The improved working capacity may arise from the reported improved litheness.

**LP:** Supplementation with one type of rose-hip powder can elevate serum vitamin C concentrations and improve running pace. Trainers reported supplemented horses to be calmer.







## **Principles of learning theory in equitation**

Does your training stand the test of science? The following 8 principles were originally defined in the peer-reviewed scientific literature (McGreevy and McLean, 2007 – The roles of learning theory and ethology in equitation. *Journal of Veterinary Behavior: Clinical Applications and Research*, Volume 2, 108-118). The application of these principles is not restricted to any single method of horse-training, and we do not expect that just one system will emerge. There are many possible systems optimal horse-training that adhere to all of these principles.

### **First principles in horse-training**

#### **1. Understand and use learning theory appropriately**

Learning theory explains positive and negative reinforcement and how they work in establishing habitual responses to light, clear signals. (Note that “positive” and “negative” when applied to reinforcement are not value judgements, as in “good” or “bad”, but arithmetical descriptions of whether the behaviour is reinforced by having something added or something taken away, e.g., pressure. For example, when the horse responds to a turn signal and the rein pressure is immediately released, negative reinforcement has been applied). It is critical in the training context that the horse’s responses are correctly reinforced and that the animal is not subjected to continuous or relentless pressure. Prompt and correct reinforcement makes it more likely that the horse will respond in the same way in future. Learning theory explains how classical conditioning and habituation can be correctly used in horse-training.

#### **2. To avoid confusion, train signals that are easy to discriminate**

There are many responses required in horse-training systems but only a limited number of areas on the horse’s body to which unique signals can be delivered. From the horse’s viewpoint, overlapping signal sites can be very confusing, so it is essential that signals are applied consistently in areas that are as isolated and separate from one another as possible.

#### **3. Train and shape responses one-at-a-time (again, to avoid confusion)**

It is a prerequisite for effective learning that responses are trained one-at-a-time. To do this, each response must be broken down into its smallest possible components and then put together in a process called “shaping”.

#### **4. Train only one response per signal**

To avoid confusing the horse, it is essential that each signal elicits just one response. (However, there is no problem with a particular response being elicited by more than one signal). Sometimes a response may be complex and consist of several trained elements. These should be shaped (or built up) progressively. For example, the “go forward” response is expected to include an immediate reaction to a light signal, a consistent rhythm as the animal moves in a straight line and with a particular head carriage. Each of these components should be added progressively within the whole learned response to a “go forward” signal.

#### **5. For a habit to form effectively, a learned response must be an exact copy of the ones before**

For clarity, a complete sequence of responses must be offered by the horse within a consistent structure (e.g., transitions should be made within a defined number of footfalls). Habit formation applies to transitions in which the number of footfalls must be the same for each transition and this must be learned.

#### **6. Train persistence of responses (self-carriage)**

It is a fundamental characteristic of ethical training systems that, once each response is elicited, the animal should maintain the behaviour. The horse should not be subjected to continuing signals from leg (spur) or rein pressure.

#### **7. Avoid and dissociate flight responses (because they resist extinction and trigger fear problems)**

When animals experience fear, all characteristics of the environment at the time (including any humans present) may become associated with the fear. It is well-known that fear responses do not fade as other responses do and that fearful animals tend not to trial new learned responses. It is essential to avoid causing fear during training.

#### **8. Benchmark relaxation (to ensure the absence of conflict)**

Relaxation during training must be a top priority, so when conflict behaviours are observed in the horse, we must carefully examine and modify our training methods so that these behaviours are minimised and ultimately avoided. To recognise the importance of calmness in enabling effective learning and ethical training, any restraining equipment, such as nosebands, should be loose enough to allow conflict behaviours to be recognised and dealt with as they emerge.

# A quick guide to statistics for non-scientists

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The 'scientific process' comprises the six steps listed below. The application of statistics is a tool which enables reliable conclusions to be reached and the research objective to be answered. Statistical analysis is not that difficult and simply involves following a series of simple steps and rules. An example is used to demonstrate the steps needed for a simple scenario where the researcher needs to apply the two sample t test in order to statistically assess the difference between two sets of data. (All text relating to the example given is highlighted with grey shading).

EXAMPLE: A study is planned to investigate the success of dressage horses trained using two different training methods (Method A and Method B).

## 1. Generating a research question

A good project will have a simple title which clearly describes the objective of the study.

Is there a difference in the success of dressage horses trained using Method A and Method B?

## 2. Identifying variables and measures

There are two types of variables – independent variables which are determined by the researcher and dependent variables which provide the measurements upon which statistical tests are conducted.

The Independent Variable is 'Training method' and has two levels: Method A and Method B.  
The Dependent Variable is 'success' – which can be measured by scores achieved in competition.

## 3. Formulating hypotheses

All research projects rely on the examination of hypotheses. Each statistical analysis relies on the simultaneous examination of a pair of hypotheses which are opposites of each other and always follow the standard format:

The Null Hypothesis ( $H_0$ ) states that *'There is no significant difference between A and B'*.

The Alternative Hypothesis ( $H_a/H_1$ ) states that *'There is a significant difference between A and B'*.

$H_0$ : There is no significant difference in the dressage scores achieved by horses trained using Method A and the dressage scores achieved by horses trained using Method B.

$H_a$ : There is significant difference in the dressage scores achieved by horses trained using Method A and the dressage scores achieved by horses trained using Method B.

#### 4. Designing the experiment ~ data collection

When designing an experiment it is important to obtain a decent sample size (n, as a rough guide is that anything less than 30 is considered to be a ‘small’ sample) and to match everything about the individuals contributing to each sample as evenly as possible.

All of the horse and rider combinations in this study will be competing at a similar level, and performing the same dressage test, under the same conditions, and be judged by the same judge.

#### 5. Data analysis

Two types of data analysis are applied, first, exploratory, descriptive analysis which provides averages and an indication of the spread of the data, and second, confirmatory statistical analysis which yields ‘test statistics’ and probabilities and ultimately allows a statistical conclusion to be reached. The latter will then allow a conclusion to be reached in relation to the objective of the study.

##### Sample data (Dressage scores, %)

###### Method A

60	60	60	50	64	56	55	56	48	44	53	53
57	59	54	52	52	59	56	61	55	50	58	56
52	62	53	67	58	51						

###### Method B

60	73	69	67	72	67	65	64	64	72	64	72
70	74	61	63	66	68	66	72	70	68	55	87
68	69	61	68	60	66						

**Exploratory, descriptive analysis** ~ of the sample data shows that horses trained using Method A achieve an average score of 55.7% with a variability of 4.93% typically presented as  $55.7 \pm 4.93\%$ . Horses trained using Method B achieved a higher score of  $67.4 \pm 5.80\%$ .

At this point the general impression is gained that there is a difference in the scores achieved by horses trained using the two different training methods.

**Confirmatory, statistical analysis** ~ is necessary in order reach a reliable conclusion. A standard process is now followed:

- Conduct a statistical test (here the two sample t test).  
This will produce a test statistic and a probability value, P.

For this example:  
 $t_{56} = 8.40$ ;  $P < 0.001$ .

## 6. Reach a conclusion

In statistics there is a one important number: **P=0.05**.

A P value of 0.05 means that if a study was repeated 100 times then 95 times out of 100 the same result would be found, and 5 times out of 100 the opposite result would be gained. As far as interpretation of results goes the P value should be less than 0.05 in order for the results to be considered to be reliable.

A simple procedure is followed to relate the P value to the hypotheses in order to reach a statistically sound conclusion:

- If the P value obtained is less than 0.05, the  $H_a$  is accepted and the  $H_o$  is rejected. The conclusion is then reached that there is a significant difference between the two samples. **The averages found in exploratory data analysis show that training Method B is more successful than Method A.**
- If the P value obtained is equal to, or greater than, 0.05, the  $H_o$  is accepted and the  $H_a$  is rejected. The conclusion is then reached that there is not a significant difference between the two samples. (Here scientists state that there is a non-significant difference.)

This guide is intended to enable non-scientists to understand the statistical references made in the abstracts and presentations during the course of the ISES international conference.



## International Society for Equitation Science

### 11<sup>TH</sup> International Equitation Science Conference

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DCA - National Centre for Food and Agriculture is the entrance to research in food and agriculture at Aarhus University (AU). The main tasks of the centre are knowledge exchange, advisory service and interaction with authorities, organisations and businesses.

The centre coordinates knowledge exchange and advice with regard to the departments that are heavily involved in food and agricultural science. They are:

Department of Animal Science  
Department of Food Science  
Department of Agroecology  
Department of Engineering  
Department of Molecular Biology and Genetics

DCA can also involve other units at AU that carry out research in the relevant areas.

## SUMMARY

The 10th International Equitation Science Conference is held in Denmark from August 6th – 9th 2014. This book of proceedings contains abstracts of 35 oral and 57 poster presentations within the conference themes Equine Stress, Learning and Training as well as free papers.

International Society for Equitation Science (ISES) is a non-profit organisation which aims to facilitate research into the training of horses to enhance horse welfare and improve the horse-rider relationship. Read more at [www.equitationsscience.com](http://www.equitationsscience.com)